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TECHNOLOGY DEPARTMENT

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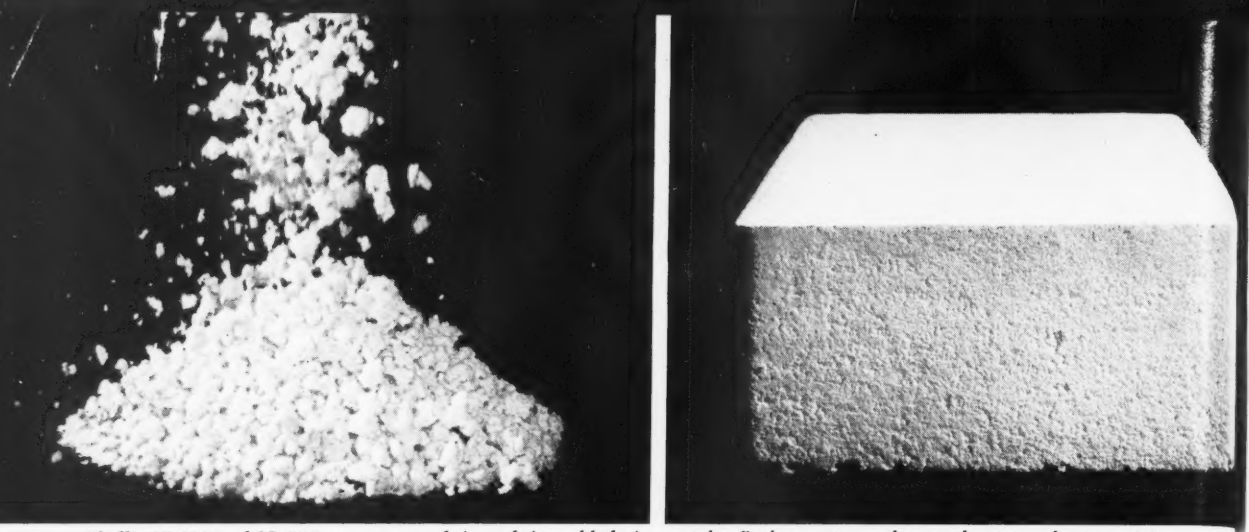
RUBBER WORLD



Shell's SP-103 and SP-102 come in crumb form, left, and bale form, right. Both contain predispersed resin to shorten mixings.

TIMESAVERS:

Shell Chemical now offers two resin-rubber masterbatches—in free-flowing crumb and solid bale form

Shell's SP-103 masterbatch contains equal parts of high styrene resin and low viscosity S-1509 rubber.

Shell's new SP-102 is identical except the rubber portion is S-1502.

Both are light-colored, nonstaining and nondiscoloring. They provide a convenient source of predispersed resin for nuclear and sponge soling, floor tile and hard rubber products requiring easy processing, flexibility and durability.

Read why these two polymers also reduce mixing time, minimize scorch hazard and eliminate resin handling.

Shell's SP-103 is made from equal parts of high styrene resin and low viscosity S-1509 cold rubber.

The high styrene resin content imparts properties such as abrasion resistance, gloss, stiffness and durability.

The cold rubber in SP-103 has a viscosity range of 30-38. This results in a uniform mixture when added to a low viscosity compound.

SP-103 is recommended for open and closed cell sponge and molded mechanical goods that require exceptional mold flow.

Higher viscosity SP-102

Shell's new SP-102 contains equal parts of high styrene resin and S-1502 cold rubber. This rubber has a viscosity range of 46-58.

SP-102 is recommended for nuclear shoe soling, floor tile—any hard rubber product that requires superior toughness and abrasion resistance.

Speeds processing

Why do these resin-rubber masterbatches reduce in-plant mixing time?

Because the resin is added at the latex stage. This means it is thoroughly blended when the rubber is delivered. Banbury masterbatching of resin and rubber is eliminated. So is the separate handling of resin.

Shell's SP-102 and SP-103 give maximum reinforcement in even the shortest mixing cycles. And there is less danger of scorch as a result of shortened mixings at lower temperatures.

Now in two forms

Both masterbatches are now available in either free-flowing crumb or 75-lb. bale form. The crumbs are packaged in 50-lb. multiwall bags. Bales can be shipped in multiwall bags or film-wrapped in clear polyethylene.

How to order

For additional information and technical specifications on SP-103 and SP-102, call a Shell Synthetic Rubber Division sales office. Locations are: Stamford, Conn. (DAvis 5-1581), Cleveland, Ohio (EDison 3-0600) and Lakewood, Calif. (SPruce 3-4997).

Shell Chemical Company

SHELL

Synthetic Rubber Division

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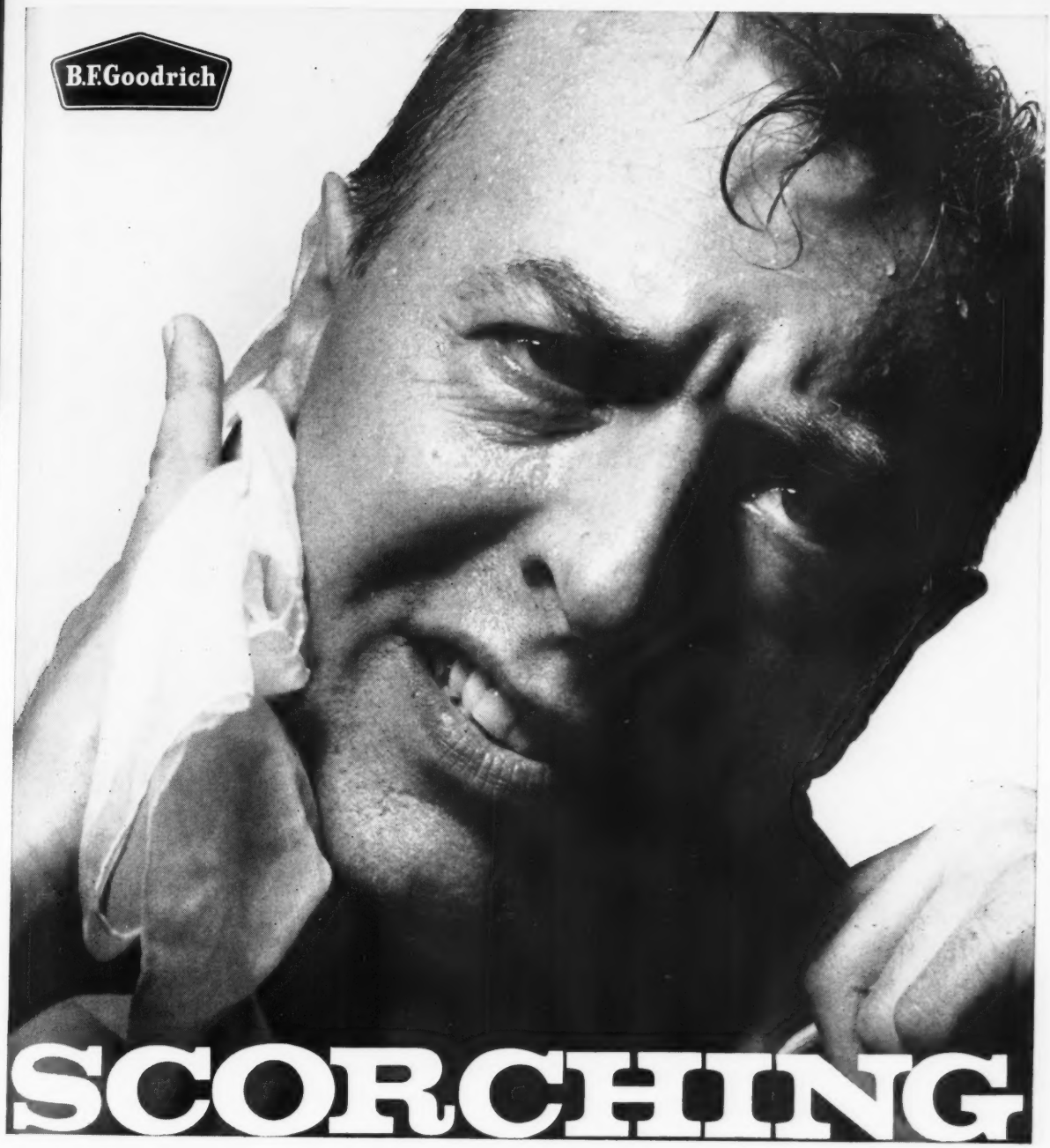

SCORCHING

summer-time is here... prepare with Good-rite Vultrol

You assure uninterrupted summer-time production by stocking up on Good-rite Vultrol. All year, Good-rite Vultrol prevents scorching by retarding cure at processing temperatures—but especially in summer. It serves as a mild activator at curing temperatures—makes possible remarkable savings in recovery of scorched stock.

Good-rite Vultrol is beneficial in the processing of highly loaded or highly accelerated compounds, too. It is particularly effective with high furnace blacks for tire-tread compounds.

No special handling is required. Good-rite Vultrol is supplied as a free-flowing flake, easy and economical to use. Get more information by writing Department MD-5, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical

a division of The B.F.Goodrich Company

Good-rite CHEMICALS

RUBBER WORLD

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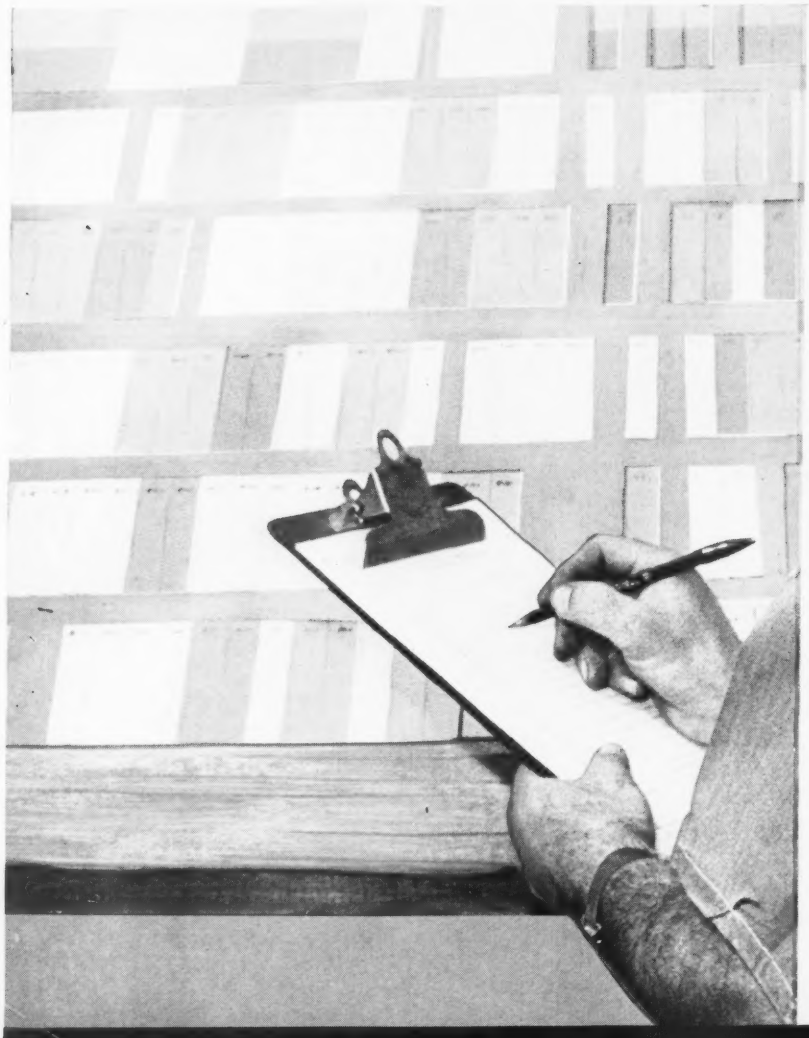

THE PENNOX SERIES

General purpose amine-type

PENNOX A—Slightly discoloring amine-type antioxidant effective in both dry rubber and latex. Provides good high temperature aging in latex.

Nonstaining, nondiscoloring phenolic types

PENNOX B—Good antioxidant for Hevea and SBR vulcanizates and raw SBR polymer.

PENNOX C—Exceptionally resistant to discoloration in light-colored latex products; provides good protection for Hevea and SBR vulcanizates.

PENNOX D—Excellent antioxidant for latex products, dry Hevea and SBR compounds.

For effective age resistance Pennox Antioxidants

In the Pennox series you'll find a dependable age resister suitable for most rubber compounding situations. Pennox antioxidants protect Hevea and SBR vulcanizates, raw SBR polymer, and latex products from the deteriorating effects of heat and oxidizers . . . also provide superior gas fading protection for latex, and minimize discoloring of fabrics coated or used in contact with latex products.

For detailed information on the Pennox series, write or ask your Pennsalt representative for Bulletin S-151, Pennox Antioxidants; and Bulletin S-152, Pennox Antioxidants for Latex. Evaluation samples available on request.

Pennox is a trade name of Pennsalt Chemicals Corp.

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news of the rubber world

June, 1961

Solid urethane elastomers are among the most important new materials in the rubber field, with demand expected to increase from 6.8 million pounds last year to over 100 million pounds by 1965. The story of the urethanes - their properties, processing and applications - will be told in the special urethane issue of RUBBER WORLD, appearing in July.

Chlorinated butyl may be blended with natural rubber, SBR, nitrile, neoprene and reclaim for a balance of properties. Curing systems for the various blends, and the resulting properties, are described in an article by Esso Research and Engineering Co. on page 85.

An all-weather tire which uses an elastomeric additive for improved traction on ice and snow will go on the Canadian market this fall. The "Tomarkin" tire is described on page 82.

Prospects of low-priced polyisoprene have been advanced by two new processes for isoprene monomer, the Goodyear-Scientific Design and Houdry processes. The processes are discussed in the synthetic rubber market review, page 124.

Improvements in processing and product quality are promised by two techniques: use of room temperature vulcanizing silicone rubber molds for prototype parts, described on page 94, and non-sulfur curing systems, outlined by a panel at a recent Philadelphia Rubber Group meeting (Meetings and Reports, Page 98).

A fire in the offices of RUBBER WORLD late last month destroyed most of the contents of our mail and supply rooms. If you should have any reason to believe any of your mail has not been received by us, please let us know. Needless to say, we'll try not to let it happen again.

(Advertisement)

It was not until the mid 40's that the furnace process was able to create a carbon black capable of dethroning the old champ—channel black—and even then there was a fortuitous assist . . . the development of cold SBR. Like a pea waiting around for a pod, HAF was born to produce superior abrasion resistance in tread stock and industrial mechanical rubber goods. But it needed a rubber that could harness its abilities. Today, no carbon black is as versatile or has as broad a range of applications; and for quite a while the industry's top volume crown is to be made to the hat size of HAF.

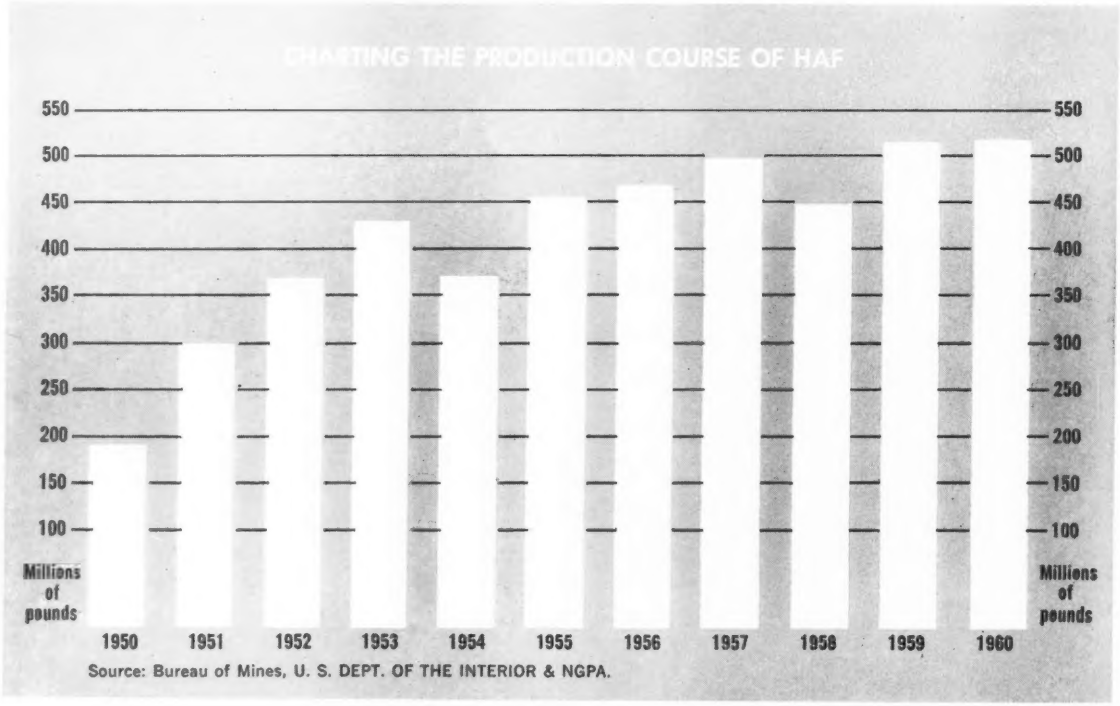
TRAVIS WHITSEL
Manager, Carbon Black Research
United Carbon Company

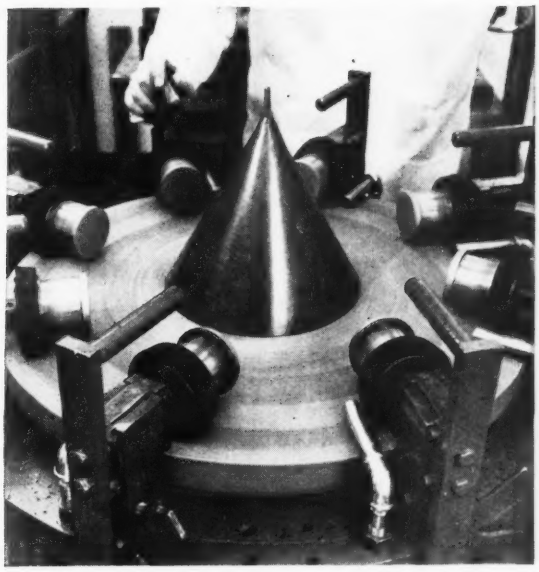
A Product in Perspective

HAF Carbon Black

The Second World War had ended. The carbon black and rubber industries, like the rest of American industry, were starting the gigantic job of returning to peace-time operations. During the war carbon black and rubber plants had done yeoman service in producing the vast quantities of conventional rubber and carbon black materials required to satisfy the immense demand of America's mechanized army for tires, tank treads and heavy duty rubber products.

Probably the most pressing need during this crisis was for an improved reinforcing carbon black produced more economically through the higher yield furnace black process. Thus the industry's research programs had been concentrating on the superior property balance available at that time only in channel blacks. The year 1945 saw the results of this research effort with the introduction of a high abrasion furnace black, HAF.





Goodyear Angle Abrader simulates abrasion similar to tire tread wear. Tests are run on 3½"-diameter specimens which are set at 11 degree angles ahead of center on a revolving grinding stone. Total volume loss is recorded after 32 minutes of revolutions at 85.4 rpm under a 32 lb. load.

Better Feedstocks and Improved Processing Control

HAF, or High Abrasion Furnace Black, is produced by the furnace process from highly aromatic oil feedstocks. The high concentration of aromatics in the oil is a key to higher reinforcing properties. Particulate configuration—"structure"—is directly relatable to the concentration of aromatics. Further, it can be stated that as the abrasion resistance of a black increases an even finer control of variables within a feedstock is required. As you ascend in abrasion resistance, the control of the carbon black manufacturing process becomes increasingly critical.

The highly aromatic oil feedstocks used today to produce HAF are almost as expensive as gasoline (before taxes, that is). Crude oil does not provide the necessary feedstock mix. Only a refined stock produced from a selected grade of crude oil and manufactured in specially designed petroleum cracking and reforming equipment will have the required degree of high concentration aromatics.

These refinery units are designed to produce antiknock gasolines, and the aromatic by-products used as HAF feedstocks are separated from the unit recycle streams.

Potentially Tremendous and Quite Temperamental

When the first HAF-natural rubber batches were mixed there was a gulping and grumbling reaction—and groans. The batches mixed hot, tubed hot, vulcanized prematurely, and gave other evidences of temperamental behavior—the old techniques did not get the job done. Once mixing and compounding techniques were mastered, a furnace black rubber compound was obtained which had better abrasion resistance and hence better roadwear than had been known before.

While new techniques tamed HAF and made it an acceptable mate in the marriage with natural rubber, it is doubtful that this furnace carbon black would have reached the top of the heap if it were not for the rubber industry's development of cold SBR.

Cold SBR seemed to have a steadying influence on a temperamental HAF. The opposite side of this compounding coin was cold SBR and channel black, but this combination was not the answer for general purpose use. This new high structure furnace black and the cold SBR combined to give a compound whose abrasion resistance was superior.

Let's examine some of the facets of this unique relationship to help clarify the picture a bit. There is a basic difference in molecular sizes to consider. The molecular weight of natural rubber is on the order of five times that of cold SBR. Milling natural rubber "breaks down" the molecules and tends toward uniformity in molecular size and weight. No similar action takes place in cold SBR to any marked extent; and, even after mixing, SBR remains an extremely non-homogeneous material as regards molecular dimensions. Thus, natural rubber has a built-in propensity for loss of "nerve" in contrast with the lack of such in cold SBR. As a consequence, natural rubber could accept any carbon black and end up in a com-

pound which could be processed. Cold SBR on the other hand needed a mechanism for losing "nerve" and the "structure" in HAF was provident.

With the advent of HAF carbon black a balance of particle size for reinforcement and structure for processing was achieved.

Significant Advantages

A review of the three significant reasons for using carbon black in rubber is in order. These are, we believe, the simplest parameters available to view a particular black in comparative terms. Briefly, they are as follows:

1. Reinforcement (wear and service life)
2. Filler (economy)
3. Processing Aid (mixing and fabrication)

As a general statement we can say that HAF carbon black has not been matched as a reinforcing agent with easy processibility and medium pricing. HAF was the industry's answer to the need for exceptional endurance at nominal cost. It is superior to channel black in roadwear and it imparts sufficient resistance to cut and crack growth, scuffing, impact, scraping, chipping, cutting and tearing.

One little known fact about HAF carbon black is its great advantage to the vast American traveling contingent. HAF helps to dissipate the static electricity generated on tires, improving car radio reception.

While SAF, Super Abrasion Furnace Black, can add as much as 25% longer wear to tires, and ISAF, Intermediate Super Abrasion Furnace Black, can increase tire mileage 10-15% over HAF, the higher raw material and manufacturing costs of these materials must give way to HAF when evaluating the economic balance of many applications. Today's costs of manufacturing the comparative channel black, EPC, or Easy Processing Channel, again established the economic balance in favor of HAF.

HAF does not have the outstanding processing ease of SRF or FEF but it can be classed as an easy processing black which offers smooth extrusions. HAF is extremely compatible with other furnace blacks as well as with the highly reinforcing channel blacks.

HAF is a major success today because it was developed to fill a big job—and because there was a parallel development in the rubber hydrocarbon field. These complementing developments are part and parcel of today's surging technological advances.

If you have a particular question relating to HAF or any other carbon black manufactured by United Carbon Company, please write to Dept. RW-6, United Carbon Company, Inc., 410 Park Avenue, New York 22, N. Y.

PROPERTIES OF HAF IN REVIEW

PROPERTIES*	UNITS	ISAF	HAF	FEF	EPC
Surface Area	Sq. M/Gm.	101.8	69.2	39.0	106.8
Particle Dia.	Mu	30.7	45.2	80.0	30.0
Volatile Matter	%	1.45	1.63	0.91	5.70
Ash	%	0.50	0.24	0.11	0.05
pH	—	9.1	9.2	9.3	4.3
Iodine Number	Mg./Gm.	125.0	76.1	47.0	75.0
Tint Comparison	—	385.0	366.0	308.0	364.0

*Property values are based on United Carbon and/or ASTM test procedures. Values given are typical.

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UNITED CARBON

THIS TIRE WILL BE PERSISTENTLY PROTECTED AGAINST O_2 AND O_3

BECAUSE IT'S COMPOUNDED WITH WING-STAY 100

Get the full story from GOODYEAR

CHEMICAL DIVISION

Here's why **WING-STAY 100** p

1. WING-STAY 100 is slowly consumed by oxygen. Many antioxidants or antiozonants protect against oxygen, but are rapidly consumed in the process. Result: Little or no protection against ozone remains. WING-STAY 100 is consumed only slowly . . . its effective resistance remains longer to provide maximum ozone protection.

2. A
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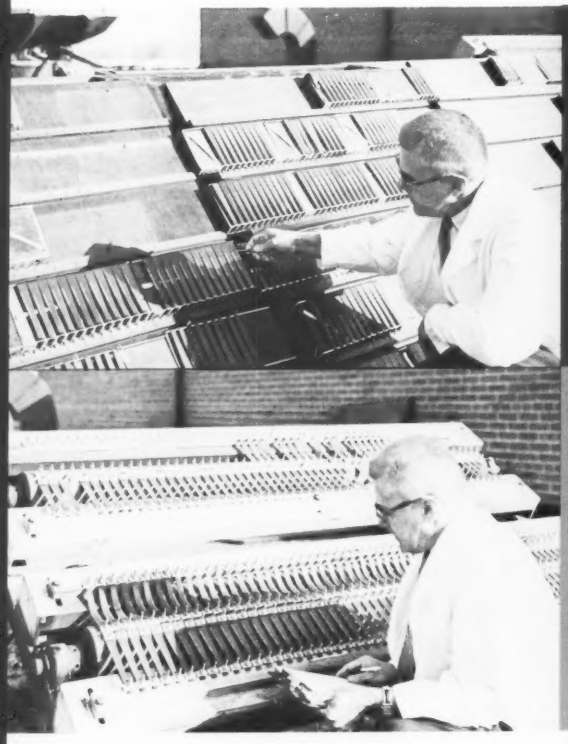
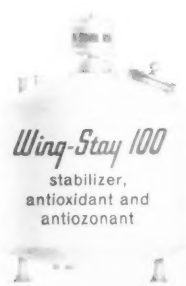
Look at this proof of the persistent p



STATIC WEATHERING TEST:
Samples pre-aged in O_3 bomb for 96 hours @ 158°F. and 300 psi. Then statically exposed on roof for 18 days @ 15% elongation.

DYNAMIC WEATHERING TEST:
Samples pre-aged in O_3 bomb for 96 hours @ 158°F. and 300 psi. Then flexed on rooftop machine for 18 days @ 15% elongation.

Then add these advantages of **WING-S**



Lots of good things come from

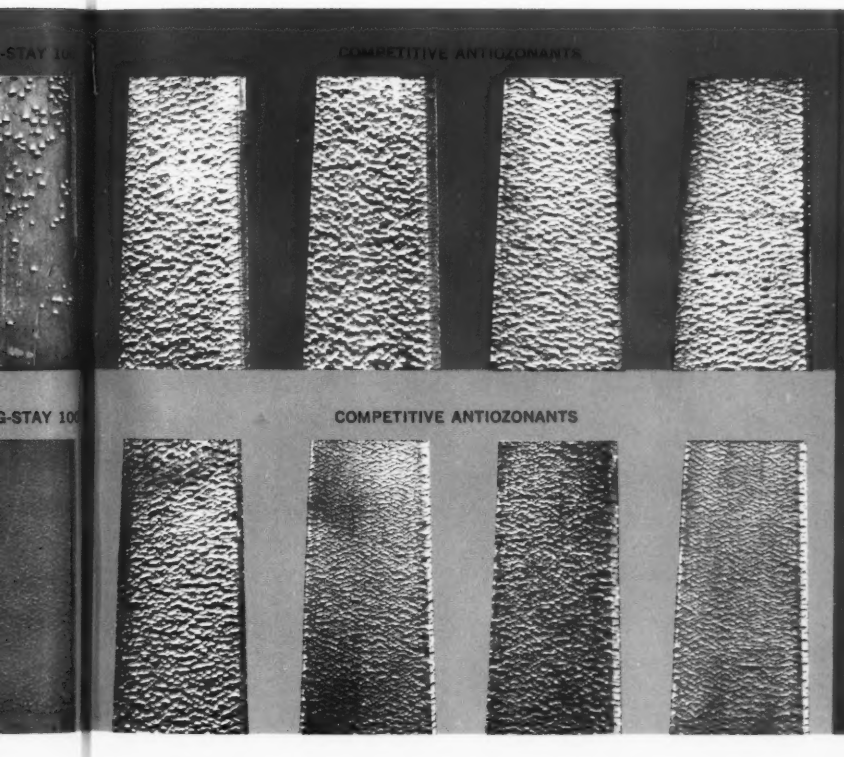
GOOD

00 persistently protects against O_2 and O_3:

2. WING-STAY 100 is more compatible with rubber—A number of antioxidant/antiozonants have limited compatibility with rubber. Result: They migrate rapidly to the surface and are lost by volatilization. WING-STAY 100 is much more compatible—provides a highly desirable, highly protective light "bloom."

3. WING-STAY 100 is less volatile—WING-STAY 100 is inherently low in volatility. Result: In contrast to the excessive "bloom" of many competitive materials, which quickly disappears, the light "bloom" of WING-STAY 100 resists volatilization by the heat and air flow of a moving tire—persists in its protection.

ent protection of WING-STAY 100:



FORMULA FOR TEST SAMPLES—DYNAMIC AND STATIC WEATHERING

PLIOFLEX 1500	100.00 parts
Zinc Oxide	3.00 "
Stearic Acid	1.50 "
HAF Black	50.00 "
145 M.P. Paraffin	0.50 "
Asphaltic Softener	10.00 "
Sulfur	1.75 "
Altax	1.25 "
DPG	0.40 "
plus	
WING-STAY 100	2.00 "

(or equivalent cost volume of competitive antiozonant)

NG-STAY 100:

1. WORKS EFFECTIVELY AS STABILIZER, ANTIOXIDANT AND ANTIOZONANT
2. INCORPORATES EASILY
3. DOES NOT ACCELERATE CURE

D YEAR CHEMICAL DIVISION

GOODYEAR

Persistent **WING-STAY 100** is readily available:

1. AS AN ADDITIVE—in easily handled, flaked, solid form for rapid incorporation into the rubber of your choice through normal compounding procedures—to give your tires, mechanical goods or other products much better over-all protection at lower cost.

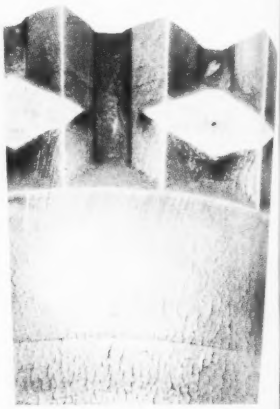
2. ALREADY INCORPORATED—*at no extra cost*—in PLIOFLEX 1500C (cold, nonextended, staining SBR), PLIOFLEX 1710C (cold, staining SBR, extended with 37½ parts of aromatic oil), PLIOFLEX 1712C (cold, staining SBR, extended with 37½ parts highly aromatic oil), and PLIOFLEX 1714C (cold, staining SBR, extended with 50 parts highly aromatic oil) —to serve as better stabilization building blocks.

SPECIAL NOTE TO POLYMER MANUFACTURERS—WING-STAY 200 IS HERE! Now you can have all the persistent protection of WING-STAY 100 in a more easily handled form. As a readily emulsified semisolid, WING-STAY 200 is completely compatible with hot and cold, oil or nonextended polymers to serve as an antioxidant during production and as a stabilization base in compounding.

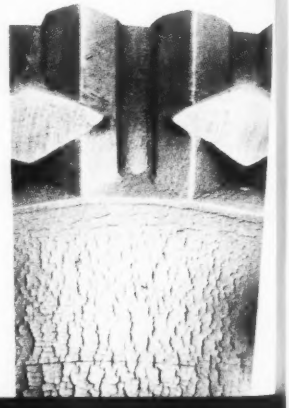
GET FULL INFORMATION and samples of WING-STAY 100, WING-STAY 200, the PLIOFLEX "C" rubbers, or any of the products in our complete line of synthetic rubbers and chemicals, by contacting your Chemical Division representative. Give him the opportunity to show you how we match our outstanding products with outstanding service. Or write Goodyear, Chemical Division, Dept. H-9418, Akron 16, Ohio.

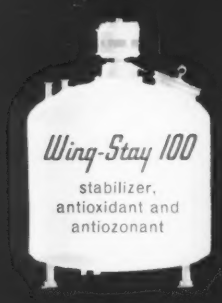
MORE PROOF OF THE PERSISTENT PROTECTION OF WING-STAY 100

OVER-THE-ROAD TEST
Akron, Ohio—14,000 miles



Tire protected with WING-STAY 100
vs.
Tire containing equal parts of competitive antioxidant





Lots of good things come from

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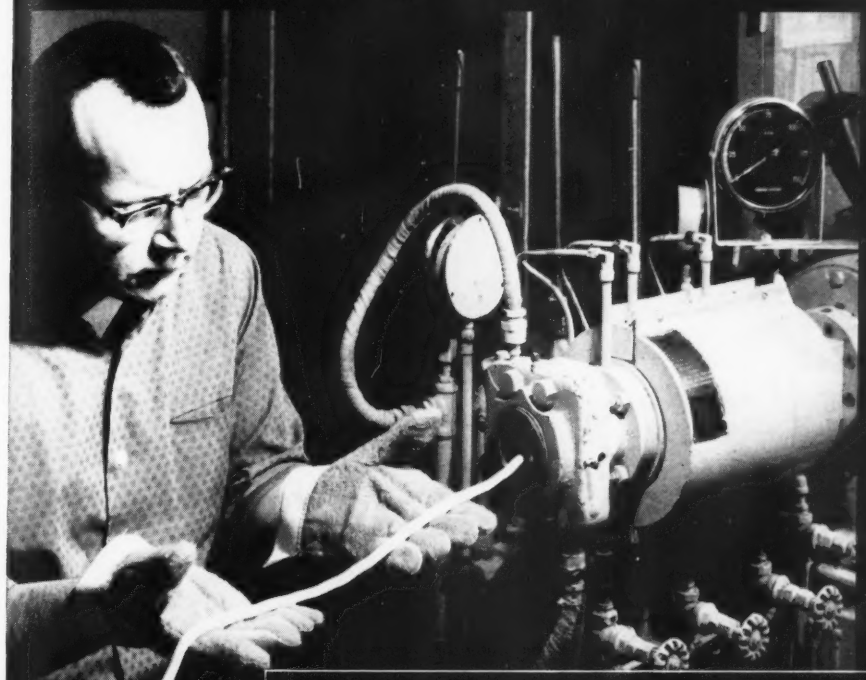
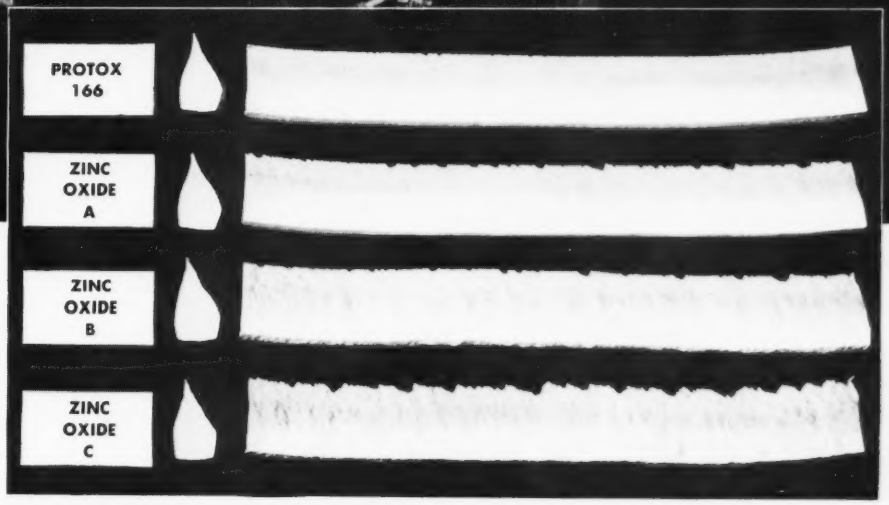
CHEMICAL DIVISION

Plioflex, Wing-Stay—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

Reduce Die Swell and Provide Smoother Surface of Extruded Stocks with...PROTOX® Zinc Oxides



The excellent extrusion properties of PROTOX-166 at 100 parts volume loading in natural rubber are shown below in comparison with conventional zinc oxides.



HORSE HEAD PRODUCTS ®

The same desirable characteristics of Protox zinc oxides that provide lower shrinkage and smoothness in calendering also impart superior properties to extruded rubber stocks.

Protox zinc oxides are outstanding in dispersion and freedom from aggregates and provide a unique plasticizing action. That's why they will enable you to reduce die swell and get smoother surface of your extruded stocks. And because they disperse readily in the mixing operation, they will help you to extend your running time before cleaning strainers.

May we show you how you can increase production efficiency of your extruded stocks with PROTOX zinc oxides?

THE NEW JERSEY ZINC COMPANY 160 Front Street, New York 38, N. Y.

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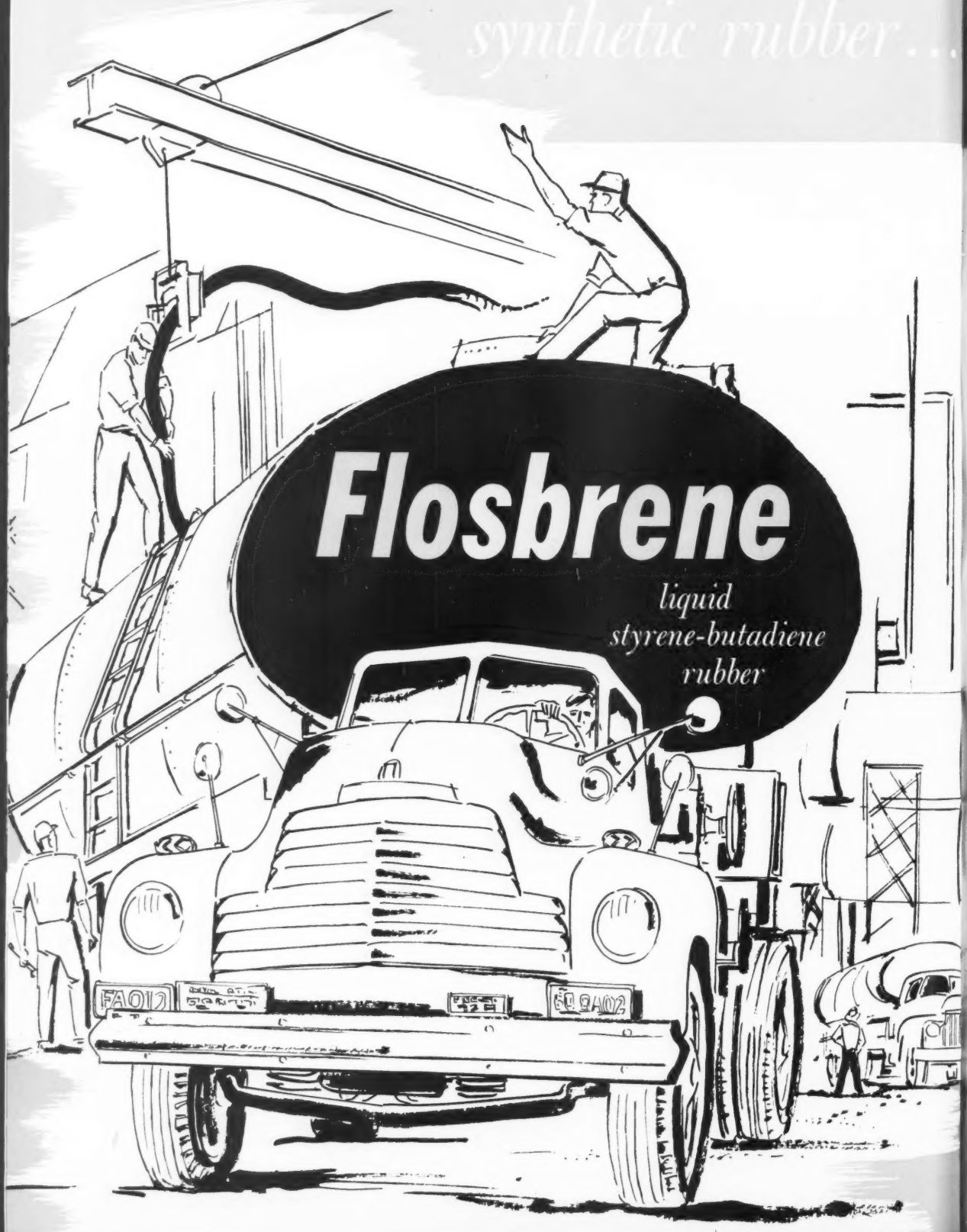
LOS ANGELES •

Bright new dimension in synthetic rubber...



LIQUID SBR

...another industry first from ASRC

FIRST TO SCORE with its cold low Mooney rubbers, ASRC now takes another forward stride with the introduction of FLOSBRENE—the first commercially available *liquid* styrene-butadiene rubber.

To many manufacturers of rubber products FLOSBRENE offers opportunities for new applications, advanced processing procedures, improved formulations. Initial customer production experience with FLOSBRENE underscores the ease with which it can be mechanically weighed, preblended, mixed and fed... its adaptability to lighter mixing equipment... the savings it provides in processing aids, mixing time, power and labor.

VISCOSITIES

FLOSBRENE is available in several different viscosity ranges as follows:

VISCOSITY—POISES		FLUID NATURE	
		Room Temp.	
25°C or 77°F	45°C or 113° F	70-75°F	150°F
VLV less than 500	—	Easy flow	Very easy flow
LV 500- 2500	—	Lazy flow	Very easy flow
MV 2500- 7500	365- 765	Thin paste	Easy flow
HV 7500-12500	765-1135	Stiff paste	Easy flow

VLV—very low viscosity
LV—low viscosity
MV—medium viscosity
HV—high viscosity

COMPARATIVE PROPERTIES

A comparison of the physical properties of FLOSBRENE to solid SBR is shown in the following test formula—

FLOSBRENE or SBR-1004	100
Hard rubber dust	100
Sulfur	40
Zinc Oxide	2
Organic accelerator	4

In this formula, FLOSBRENE (type VLV) gave tensile strengths of 7430 at 4.3% elongation with a hardness of 83-81. Under identical conditions, solid SBR-1004 gave a tensile strength of 7600 at 5.4% elongation with a hardness of 83-82. An additional 3 parts of sulfur added to the FLOSBRENE compound brings the physical properties even closer to the solid SBR-1004.

EXTENSIVE APPLICATIONS

FLOSBRENE offers comparative advantages in a wide variety of applications:

- For pouring or casting in conventional open-top molds where inserts can be pressed into place
- For rotational casting, as in making vinyl playballs
- For frictioning onto fabric by the calender method, for tires and belts
- For spread coating by doctor blade, as in rain-proofing or rubber coating
- As an additive to asphalt for paving, roof coverings, etc.
- As a reinforcing agent in the manufacture of high impact polystyrene resins
- As the base stock in the compounding of cements, adhesives, hard rubber products
- As an effective plasticizer for solid SBR

For further information and no charge samples of FLOSBRENE, see your ASRC representative.

ASRC
THE FIRST NAME IN SYNTHETIC RUBBER

AMERICAN SYNTHETIC RUBBER CORPORATION

EXECUTIVE OFFICES AND PLANT • LOUISVILLE 1, KENTUCKY *General Sales Offices:* **500 Fifth Avenue, New York 36, N. Y.**

1130 Second National Bldg., Akron 8, O. 38 S. Dearborn St., Chicago 3, Ill. 1909 Riverbend Pkwy., Fremont, O.

VULCANIZED VEGETABLE OILS

rubber substitutes

THE CARTER BELL MFG. CO.
SINCE
CARTER BELL PRODUCTS
1903
SPRINGFIELD, NEW JERSEY

Types, grades and blends for every purpose, wherever Vulcanized Vegetable Oils can be used in production of Rubber Goods— be they Synthetic, Natural, or Reclaimed.

A long established and proven product

THE CARTER BELL MFG. CO.
SPRINGFIELD, NEW JERSEY

Represented by
HARWICK STANDARD CHEMICAL CO.

Akron, Boston, Chicago, Pico Rivera (Cal.), Trenton, Albertville, (Ala.), Denver, Greenville, S.C.

new materials

SE-9008—Non-Milling Silicone Rubber

SE-9008, a non-milling silicone rubber compound which can be used as extruded insulation on power cable, fixture wire, and motor and apparatus lead wire, has been put on the market by General Electric Co., silicone products department, Waterford, N. Y. Its properties, as extruded on wire, include a tensile strength of 800 psi.; elongation of 550; and electric strength of 700 volts per mil.

Butyl-Lithium Solid

Lithium Corp. of America, Inc., Minneapolis, Minn., is producing on a commercial basis a new solid form of n-butyl-lithium. A homogeneous suspension of n-butyl-lithium in a specially blended paraffin wax medium, the new material is non-pyrophoric, is classed as a flammable solid, and is said to have good stability on moderate exposure to air.

Compared to conventional forms, the new solid offers greater convenience and safety in storage, shipping, and use, the company states. Formerly, this chemical was commercially available only in hydrocarbon solutions. Because such solutions were pyrophoric, especially in high concentrations, they required special shipping and storage containers as well as unusual precautions in use. Handling costs were correspondingly higher, and the special shipping containers had to be returned.

Acrylic Monomers

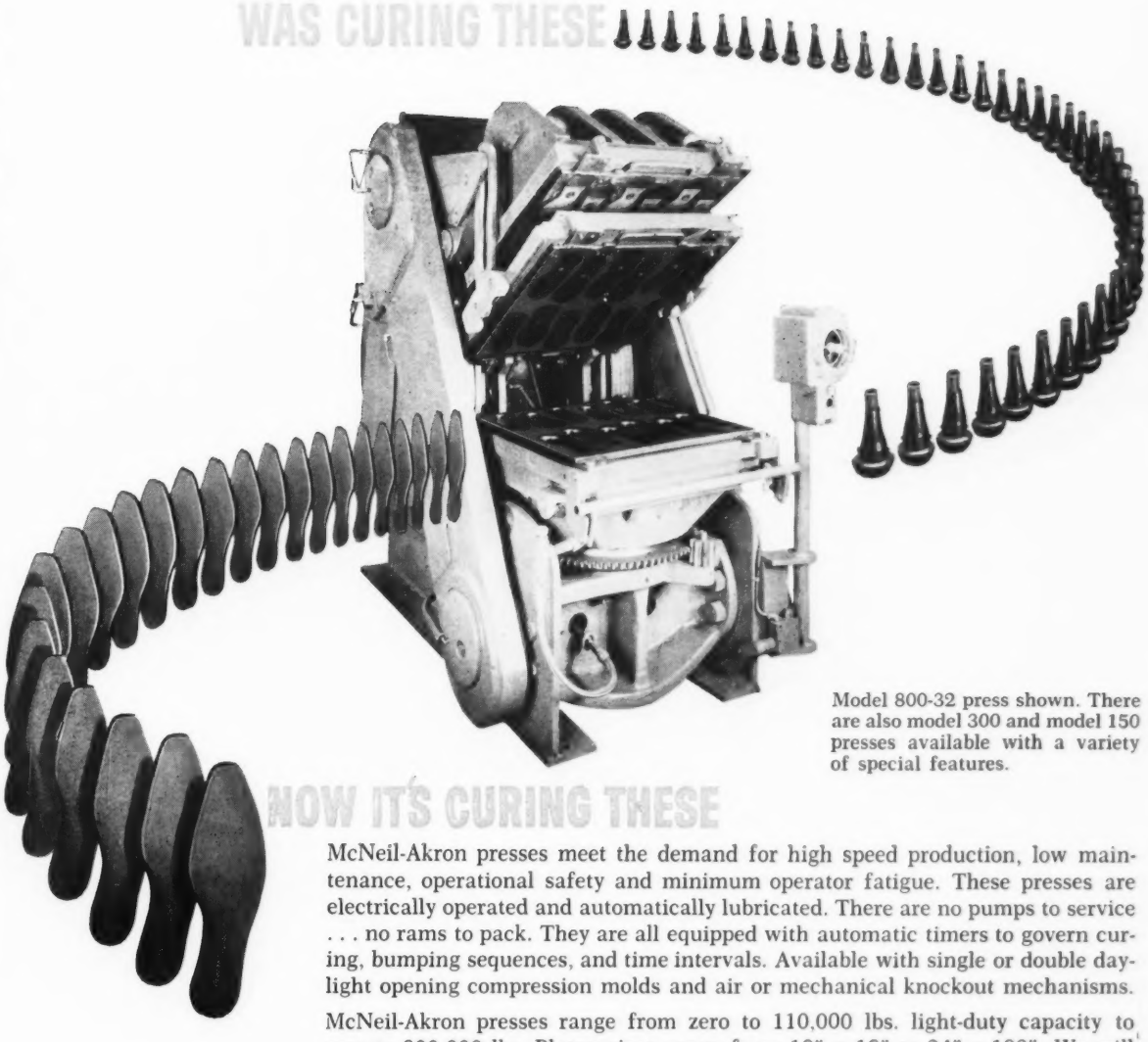
Commercial quantities of dimethylaminoethyl methacrylate (DMAEMA) and *tert*-butylaminoethyl methacrylate (t-BAEMA) are now available from Rohm & Haas Co., Philadelphia, Pa. These compounds are readily polymerizable acrylic monomers which provide a means of introducing pendant, reactive amine groups into plastics, elastomers, coatings, and fibers, the company states. They may also be useful chemical intermediates as their amine groups and double bonds can enter into a wide variety of reactions, the manufacturer also reports.

Applications of DMAEMA or t-BAEMA polymers include adhesion improvement at the rubber-fiber interface in tires and in multi-layer coating systems, anti-static agents for synthetic fibers, ion exchange resins, and soil conditioners.

Changeability that means Flexibility

JUST HOURS AGO THIS McNEIL AKRON PRESS

WAS CURING THESE



Model 800-32 press shown. There are also model 300 and model 150 presses available with a variety of special features.

NOW IT'S CURING THESE

McNeil-Akron presses meet the demand for high speed production, low maintenance, operational safety and minimum operator fatigue. These presses are electrically operated and automatically lubricated. There are no pumps to service . . . no rams to pack. They are all equipped with automatic timers to govern curing, bumping sequences, and time intervals. Available with single or double daylight opening compression molds and air or mechanical knockout mechanisms.

McNeil-Akron presses range from zero to 110,000 lbs. light-duty capacity to zero to 800,000 lbs. Platen sizes range from 10" x 16" to 24" x 188". We will be glad to give you complete details or help you with your molding problems. Just write or call.

THE NAME TO REMEMBER FOR PRECISION

McNEIL AKRON

Manufacturers of the World's Finest Rubber Curing Equipment

MANUFACTURING AGENTS: Francis Shaw & Company, Ltd., Manchester, England; Vickers-Ruwolt Proprietary, Ltd., Victoria, Australia; Luigi Pomini, Soc. in Acc. di Luigi e Carlo POMINI fu Egidio e C, Castellanza, Province of Verese, Italy; Etablissements Repiquet, Bobigny (Seine), France; Harburger Eisen Und Bronze-Werke A. G., Hamburg-Harburg, Germany.

THE McNEIL MACHINE & ENGINEERING CO.

96 E. Crosier St., at Sweitzer Ave. Akron 11, Ohio

SYNPOL

More than 30 SYNPOL® SBR Polymers to fit your needs

Looking for an SBR rubber to improve your product? Then don't take chances ...pick one of the more than 30 SYNPOL polymers to improve present products ...make new ones more marketable.

The SYNPOL line of SBR polymers means "versatility at its best" in hard, tough rubber that takes maximum abuse...in soft rubber that adds lasting resilience to so many products...in coated fabrics that are lightweight, flexible, and guard against the elements.

Does your product need color? Make SYNPOL your choice again. There are SYNPOL polymers available that may be tinted with light, bright pastel shades that won't discolor or stain...put more consumer acceptance in your products.

The world of SYNPOL is constantly enlarging. To give manufacturers new opportunities in product design, TEXUS chemists are continually developing new polymers for all types of processing...black, cold, hot, cold oil-extended, and black oil-extended. Try a SYNPOL. For information about any product application, write to the address below.

TEXUS *Pace Setter in Synthetic Rubber Technology*

TEXAS-U.S. CHEMICAL COMPANY, 9 Rockefeller Plaza, New York 20, N. Y.
JUdson 6-5220

ESTER GUMS All Types. Glycerine and pentaerythritol esters of gum, wood, polymerized wood, hydrogenated wood, dimerized wood and tall oil rosins.

PURE PHENOLIC RESINS Heat Reactive, Novolac Type, Thermoplastic and Terpene. A wide variety of resins intended primarily for tackifying and reinforcing neoprene, acrylonitrile and other synthetic elastomers.

PLASTICIZERS Polymeric and Chemical. A wide range of polymeric and monomeric plasticizers and epoxidized oils for the compounding of neoprenes, nitriles, and other synthetic elastomers.

CHEMICALS Phthalic anhydride, maleic anhydride, pentaerythritol, formaldehyde, methanol, phenol and phenol derivatives.

Creative Chemistry . . Your Partner in Progress

REICHHOLD

REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N.Y.

new materials

Dry Mold Release—S-122-C

Miller-Stephenson Chemical Co., Inc., South Norwalk, Conn., has developed a dry mold release and lubricant that can be sprayed on parts and materials as a color coating. Marketed as S-122-C, the agent is based on a fluorocarbon dispersion that performs effectively under conditions of high temperature (up to 500° F.). It can be used as a mold release for electronic potting and encapsulating, injection and compression molding of phenolic and epoxy resins and silicone rubber, and as a general mold release and lubricant for rubber, plastics, and metal goods.

First Butyl Latex

Enjay Chemical Co., New York, N. Y., has announced commercial availability of butyl in latex form for the first time. The product, Enjay Butyl latex 80-21, contains about 55% solids.

The latex can be compounded with pigments, fillers, thickeners, and tackifiers, is compatible with a wide range of resin and elastomer emulsions, and can be vulcanized by curing with sulfur, zinc oxide, and other ultra-accelerators, Enjay claims.

The material is recommended for tire cord dipping in the manufacture of butyl tires, and it is suggested that the material's low permeability to water vapor, air, and other gases makes it suitable for use in air-barrier and food-wrapping papers, as well as for textile dips and coatings, adhesives, emulsion paints, roof coatings, and leather coatings.

Enjay Butyl latex 80-21 is priced at 35¢ per pound solids tank cars, f.o.b. Baton Rouge, La., and 35¢ per pound solids in drums.

Some characteristic physical properties are:

Color	White
Total Solids, wt. %	54–55
Sp. gr., 70° F.	0.96
Density, lbs./gallon	8.1
pH (glass electrode)	5–6
Particle size, microns	
Average	0.5
Range of 95%	0.05–1.0
Surface tension at 70° F., dynes/cm	30–38

Synpol 8104 and Synpol 8209B

Texas-U.S. Chemical Co., New York, N. Y., recently announced two new Synpols, 8104 and 8209B. The former is a new low-Mooney cold SBR with a non-staining, non-discoloring stabilizer. This polymer is designed as a replacement for normal-Mooney cold SBR's in sponge compounds, and as a process aid in highly loaded compounds where its low viscosity will improve extrusion, calendering, and mold flow. According to the company, Synpol 8104 exhibits superior light discoloration resistance and is useful for producing the lightest color vulcanizates, with such suggested applications as blown shoe soling, calendered soft soling, light-colored cable jacketing, calendered goods, rug underlay, injection moldings.

(*Continued on page 111*)

Ameripol Rubber helps ball maker bounce back into competition

Intensified competition in selling sponge rubber balls inspired a thorough cost study by Barr Rubber Products Company. To help make it, they called in a Goodrich-Gulf sales engineer. A switch from natural rubber to an Ameripol synthetic rubber polymer really produced results. Barr was able to cut its raw material costs substantially. Quality of the end product is maintained at the same high level, and processibility improved. If you make or use rubber products, check Goodrich-Gulf. We produce the broadest range of synthetic rubber polymers, and offer complete technical service that can help you make improvements. Contact Goodrich-Gulf Chemicals, Inc., 1717 East 9th Street, Cleveland 14, Ohio.

Ameripol
THE PREFERRED RUBBER

Goodrich-Gulf Chemicals, Inc.

WORLD'S LARGEST SOURCE OF SYNTHETIC RUBBER

NEWS FROM GOODRICH-GULF

NEW SYNTHETIC RUBBER CAN REPLACE NATURAL 100% IN HEAVY DUTY TIRES

Goodrich-Gulf is now proceeding with a multi-million dollar plant for the commercial production of Ameripol CB (cis-polybutadiene) rubber. CB is the only known polybutadiene rubber which can be used as a 100% replacement for natural rubber in heavy duty tire treads.

In over 5 million miles of test driving on Ameripol CB tire treads, up to double the tread life of natural rubber has been achieved. Superiority is greatest in very severe conditions including heavy loading, long distances, and high-speed turnpike driving.

The first Goodrich-Gulf plant unit will produce at an annual rate of 20 million pounds. In addition, other companies will produce CB under license.

Ameripol CB has qualities which may be advantageous in applications beyond tires. Good electrical properties, abrasion resistance can provide superior coverings for electrical wires that are subjected to mechanical wear. Outstanding flex properties suggest superior performance in power transmission belting and conveyor belting.

This new development complements Goodrich-Gulf's production of Styrene-Butadiene Rubber (SBR) in non-pigmented hot, cold, and oil-extended types; and micro-black masterbatch cold, and cold oil-extended types.

Ameripol
THE PREFERRED RUBBER

TYPICAL PHYSICAL PROPERTIES

(Based on test recipe of 100.0 parts Ameripol 4604, 40.0 parts EPC Black, 5.0 parts zinc oxide, 1.5 parts stearic acid, 2.0 parts Benzothiazyldisulfide, 2.0 parts sulfur).

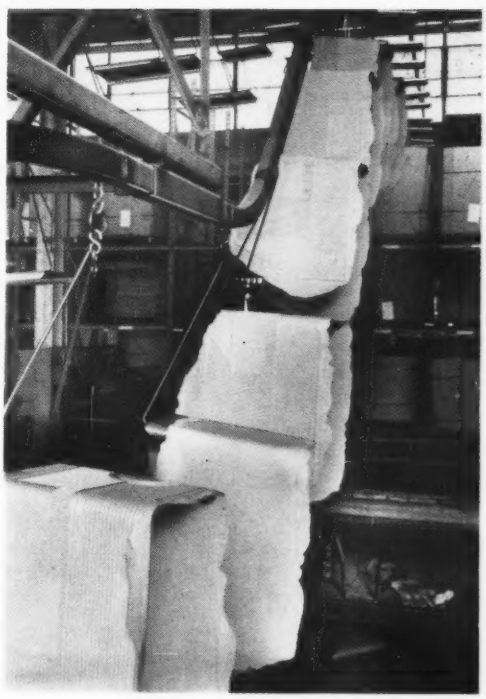
Raw Viscosity, ML-4 @ 212°F.		40
Compound Viscosity, ML-4 @ 212°F.		51
	Cure @ 292°F.	
Tensile, psi	50′	3080
Elongation, %	50′	745
Modulus, 300%, psi	25′	310
300%, psi	50′	830
300%, psi	100′	1260

AMERIPOL 4700 CUTS FLOOR MAT COST

Each one of these automobile floor mats coming down the conveyor line at Anchor Industries, Inc., Cleveland, represents a savings over the previous rubber polymer used.

The mats are made from Ameripol 4700, which is a 50-part oil-extended rubber; thus costs substantially less than low-oil polymers. Ameripol 4700 maintains the high quality level this company has established; permits processing in a range of colors.

Since Goodrich-Gulf produces the broadest range of SBR polymers, we are in excellent position to help you in selecting the type which exactly meets your needs.



Goodrich-Gulf Chemicals, Inc.

1717 East Ninth Street • Cleveland 14, Ohio

Ameripol
THE PREFERRED RUBBER

YOU GET THE WIDEST SELECTION OF SBR POLYMERS FROM GOODRICH-GULF ...WITH TECHNICAL SERVICE TO HELP YOU IN PROPER APPLICATION

Ameripol NON-PIGMENTED RUBBERS

NON-PIGMENTED HOT RUBBERS

1000 Staining. General purpose rubber, easy processing, good aging, for wide range of molded and extruded products.

1001 Slightly staining. General purpose rubber, similar to Ameripol 1000, used where less discoloration is required.

1002 Staining. Similar to Ameripol 1000, exhibits more tack in processing.

1006* Non-staining. General purpose rubber for light colored and white products.

1007 Staining. Good electrical resistance properties. Reduced water absorption.

1009* Non-staining. Has little or no nerve in milling, used as a processing aid in other rubbers.

1011 Non-staining. Tackier in processing than Ameripol 1006, used in adhesives, tapes, molded and extruded goods.

1012* Non-staining. High Mooney 1006. Ideal for cement applications. Excellent flow characteristics and high green strength in compounded stocks. Used to increase tensile and hardness in non-black stocks.

1013* Non-staining. High bound styrene content provides greater thermal plasticity and excellent flow characteristics.

*Available in either bale or crumb form.

NON-PIGMENTED COLD RUBBERS

1500 Staining. General purpose cold rubber, better physicals, usually better processing than hot rubbers.

1501 Slightly staining. Similar to 1500, better resistance to staining and discoloring.

1502 Non-staining. General purpose rubber for light colored and white products.

1509 (formerly 4601) Non-staining. Coagulated with Alum making it suitable for low water absorption applications. A medium low viscosity polymer.

1511 (formerly 4600) Non-staining. For light colored and white products. Good physicals on aging. Fast pigment incorporation. Reduced Mooney viscosity.

4604 Non-staining. High bound styrene polymer which is extremely suitable for sponge work, both open and closed cell. Has good processing characteristics.

NON-PIGMENTED OIL-EXTENDED RUBBERS

1703 Non-staining. General purpose 25-part naphthenic oil-extended polymer.

1705 Staining. General purpose 25-part aromatic oil-extended, improved processing and aging.

1707 Non-staining. General purpose where higher oil, 37½-part, can be used. Contains rosin acid for extra tack.

1708 Non-staining. 37½-part oil-extended, highly resistant to discoloration and stain.

1710 Staining. Similar to 1705, higher oil level. Easy processing, excellent physicals at lower cost.

1712 Staining. 37½-part oil-extended, superior processing.

4700 Non-staining. 50-part oil-extended, for greatest economy.

Ameripol MICRO-BLACK MASTERBATCH RUBBERS

MICRO-BLACK MASTERBATCH COLD TYPES

1605 Non-staining. Easy processing extrusion polymer with 50 parts of FEF black also suitable for manufacture of high quality molded goods.

1606 (formerly 4659) Staining. 52 parts of HAF black and 10 parts of HA oil. Used sucessfully for retreading.

1608 (formerly 4664) Staining. A quality tread rubber consisting of 52 parts of ISAF black and 12.5 parts of HA oil.

1609 (formerly 4667) Staining. This SAF Micro-Black can be used to an advantage in applications requiring high abrasion resistance; premium quality products can be made from this polymer. Made of 40 parts SAF black and 5 parts HA oil.

1610 (formerly 4660) Staining. 52 parts ISAF black and 10 parts HA oil. High abrasion resistance suitable for tires camelback.

4651 Staining. 62.5 parts of HAF black and 12 parts of HP oil. Used in camelback tires and mechanical goods.

MICRO-BLACK MASTERBATCH COLD, OIL-EXTENDED TYPES

1805 Non-staining. A low cost general purpose rubber of 75 parts HAF black and 37.5 parts N oil.

1808 Staining. This 75 parts HAF black and 50 parts HA oil polymer is very suitable for camelback and low cost molded and extruded goods.

1809 Staining. 75 parts HAF black and 37.5 HA oil. Applications include tires, camelback and mechanical goods.

4756 Staining. Intermediate loading of black and oil produces quality tread stocks. Contains 75 parts HAF black and 37.5 parts A oil.

4758 Staining. A low cost tread rubber consisting of 82.5 parts of ISAF black and 62.5 parts of HA oil.

4759 Staining. 75 parts ISAF black and 37.5 parts A oil. Applications include high quality camelback and tires.

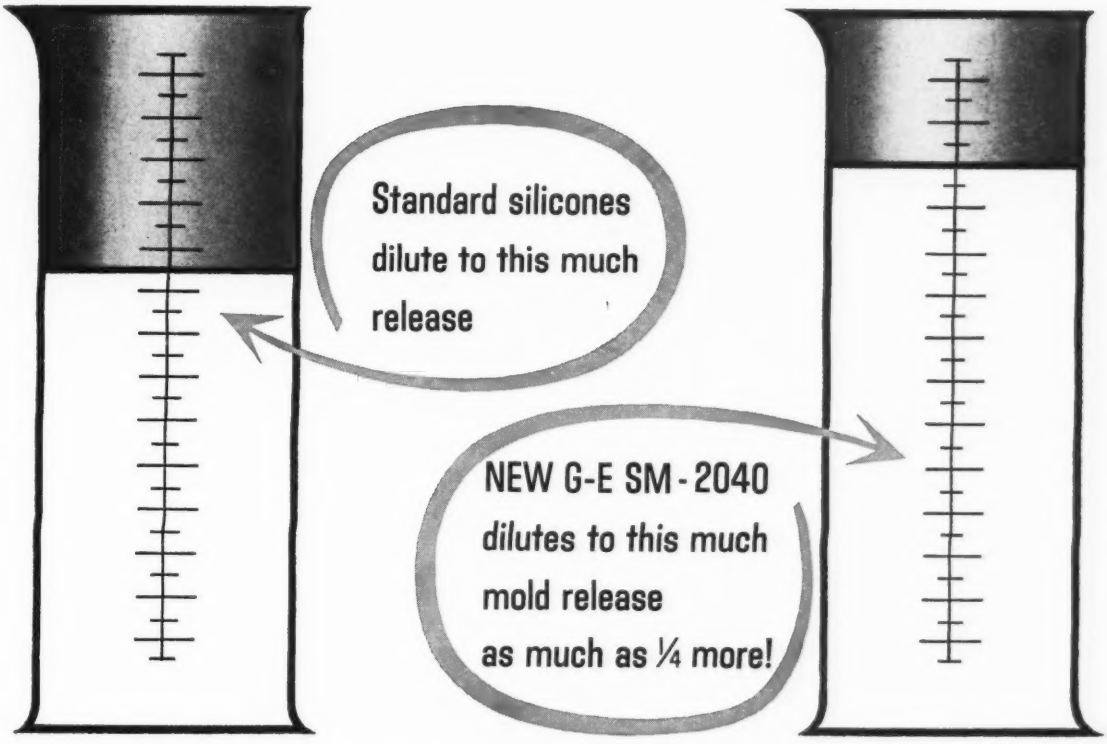
For service in the preferred rubber call...

Goodrich-Gulf Chemicals, Inc.

Cleveland: 1717 East Ninth Street • Phone: TOwer 1-3500
New York: 200 East 42nd Street • Phone: MUrray Hill 7-4255
Chicago: 6272 West North Avenue • Phone: NAtional 2-3722

SILICONES

Cut mold-release costs up to 25%



New General Electric SM-2040 silicone emulsion gives easier release, cleaner molds, drier, brighter surface . . . at cost savings up to 25 percent

Designed for maximum economy in rubber and plastic mold-release applications, new General Electric SM-2040 flows easily for complete and uniform coverage—with minimum transfer to the molded goods. You use less silicone and save as much as 25% (see table).

Dilution and freeze-thaw stability are excellent. SM-2040 contains no organic solvents or additives and only a minimum of emulsifier. Build-up of organic residue is greatly reduced so that molds and dies stay clean longer.

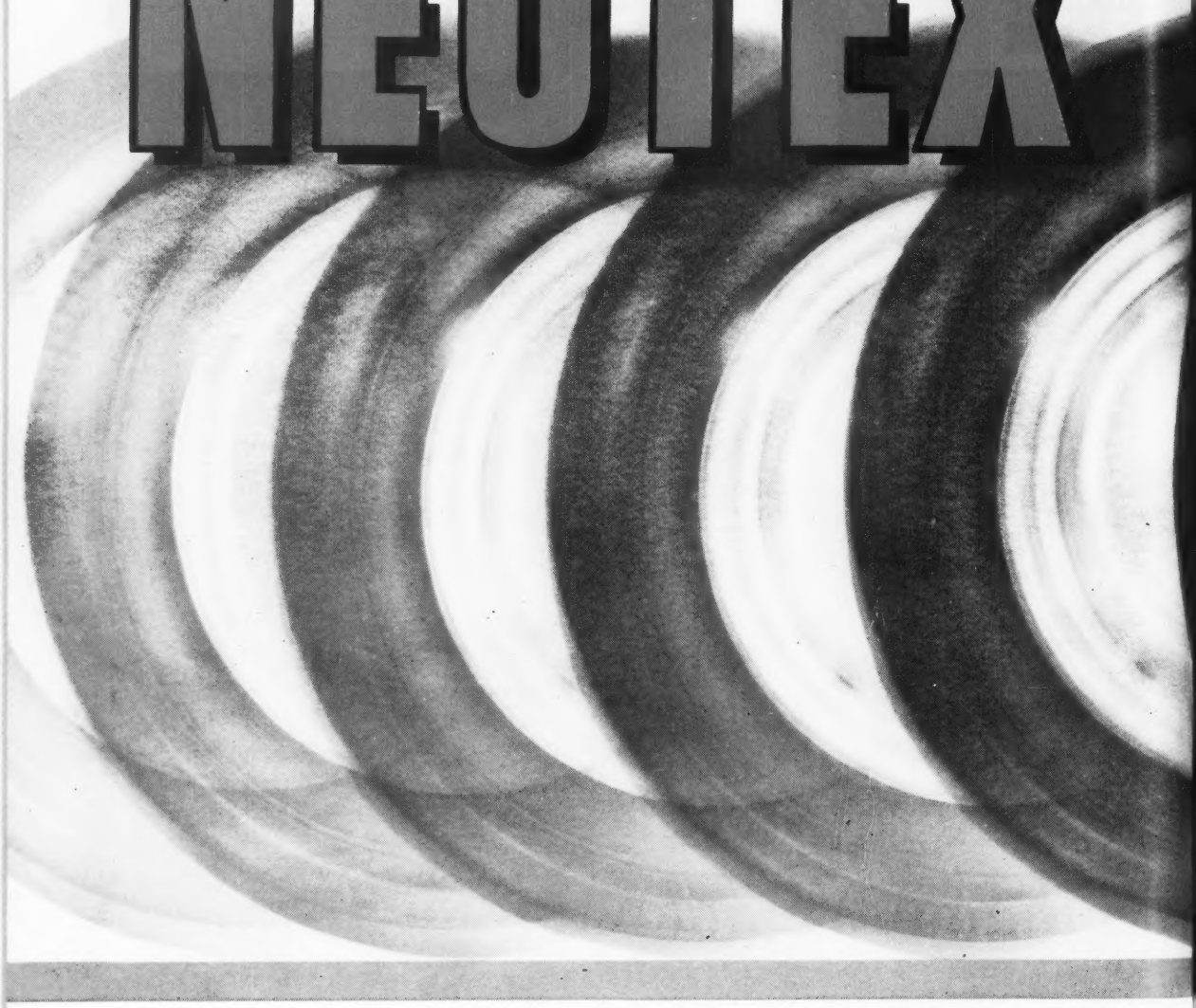
SM-2040 is now available from the General Electric Silicone Products Dept. or the Harwick Standard Chemical Company.

For additional information and a free test sample, write General Electric Company, Silicone Products Dept., Section 11650, Waterford, N. Y.

If you now dilute a gallon of conventional silicone emulsion with this much water:	Mold spray cost/gallon	You can dilute a gallon of G-E SM-2040 with this much water:	Mold spray cost/gallon
35 gal.	25¢	45 gal.	19½¢
70 gal.	12½¢	90 gal.	10¢
100 gal.	9¢	130 gal.	7¢

GENERAL ELECTRIC

NEOTEX®



Industry asked for a softer ride.

NEOTEX 100

...in the HAF fineness range...develops low modulus...for use in carcass stocks, natural rubber treads, high grade mechanicals, etc.

NEOTEX 130

...in the ISAF fineness range...develops low modulus, good tensiles, high elongation and lower Shore Hardness ...for improved ride in passenger tires.

NEOTEX 150

...in the SAF fineness range...produces highest tensiles of any rubber carbon ... gives best ride-noise-tread wear combination ...tailor-made for the Black Rubber process.

COLUMBIAN CARBON COMPANY B-2
380 Madison Avenue, New York 17, N. Y.

Tell me more about NEOTEX!

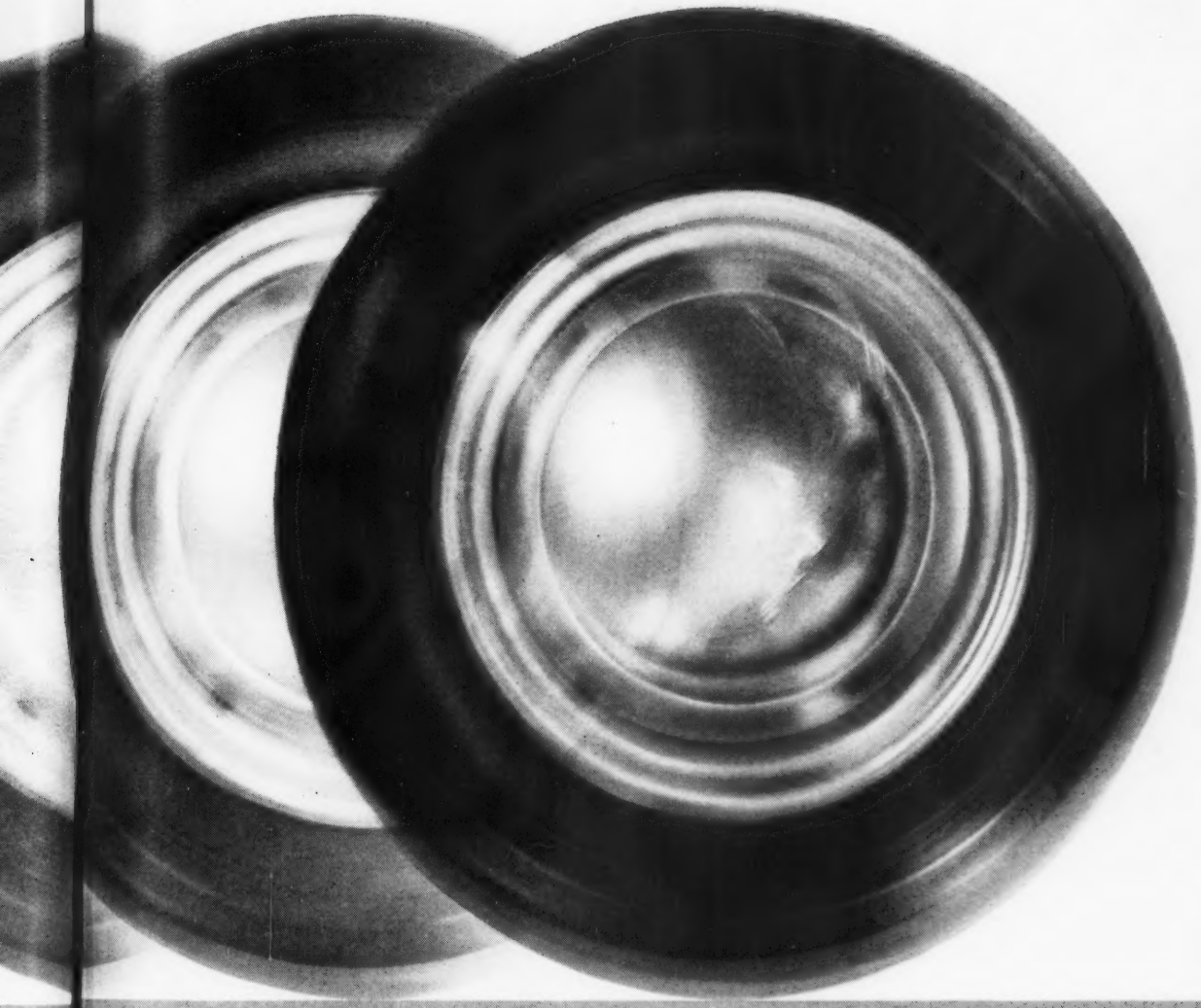
Name.....

Position.....

Firm.....

Address.....

City.....Zone.....State.....



de less noise . . . good wear:

COLUMBIAN DID IT!

Once again, with the development of the NEOTEX series, Columbian has led the way for finer-quality products, both in tires and industrial rubber goods. Through NEOTEX, the compounder can get oil furnace blacks that provide high tensile, low modulus and low hardness. And now, with the *immediate availability* of NEOTEX, you have the quality carbon black you asked for: good wear, less noise, softer ride. Contact your Columbian representative . . . and send off the coupon for the whole story . . . *today*!

COLUMBIAN CARBON COMPANY

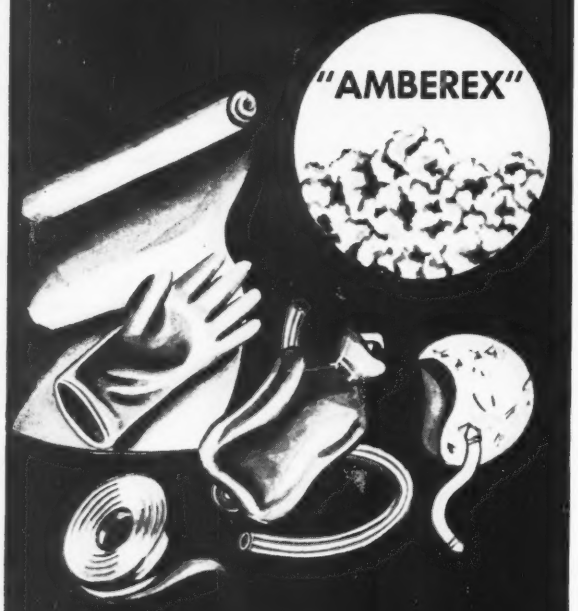
380 Madison Avenue, New York 17, N. Y.

Branch offices and agents in principal cities

ADD "AMBEREX" TYPE

Factice®

VULCANIZED VEGETABLE OIL
TO YOUR COMPOUND



for Rapid Incorporation Rate and
Better Dispersement of Pigments.

Typical products using Factice® "Amberex" in compounding formulas.

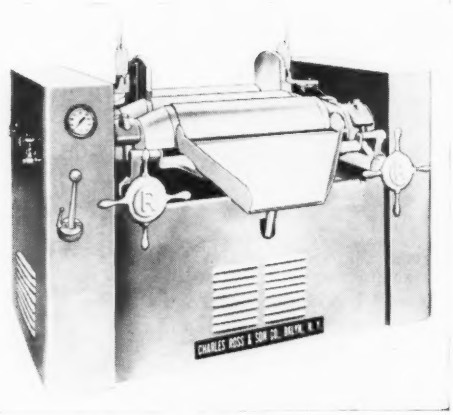
The Amberex type of Factice® is made from various kinds of vegetable oils and in various degrees of polymerization. All are light colored, transparent, free from chlorine and have practically no ash.

There are six different Amberex types, each having properties for specific applications. The selection of the proper Factice® for a compound is important. Send us your formula for our suggestions. All formulas held in strict confidence. Our trained staff will help in selecting the proper vulcanized vegetable oil for your need . . . Factice®, White, Brown, Neophax or Amberex.

Factice — THE STAMFORD RUBBER SUPPLY CO. — Vulcanized Oil

THE STAMFORD RUBBER SUPPLY CO.
STAMFORD, CONN.

new equipment



Hydraulic apron adjustment and pressure gage

Apron Adjustment and Pressure Gage

A new hydraulic apron adjustment and knife pressure-indicating gage is being marketed by Charles Ross & Son Co., Inc., Brooklyn, N. Y., as standard equipment in all size three-roll mills.

The built-in hydraulic apron adjustment enables apron and knife to be quickly set to any predetermined pressure against the front roll, or released for cleaning. Knife pressure against front roll remains constant as knife wears, providing a more positive control over production. The uniform knife pressure gives a continuous thorough takeoff of material from front roll and, by preventing dispersed material from passing under the scraper knife and cycling back into the mill, enables each size mill to deliver 10-20% greater production than was previously possible, the manufacturer reports.

It is also said that extra-thin razor knives with the uniform pressure clearly visible on the dial have also resulted in reducing scoring of rolls due to improper knife pressure.

Improved Specimen Cutter

Testing Machines, Inc., Mineola, N. Y., has introduced the new Mooney specimen cutter, which produces two disks 1¾ inches in diameter, one blank, and the other with a ⅜-inch-diameter hole in the center. The cutter can be used in a standard speci-

(*Continued on page 34*)

Another Precision Product made from S.P. Rubber

SP stands for "superior processing": it also means speed and precision in extruding, calendering and moulding. What more do you want? Well, of course, you want PA 80 RUBBER, the latest and most versatile addition to the SP Rubber family from Malaya. PA 80 gives you all the SP benefits in an even more convenient form.

Blend in 1 : 3 ratio with any grade of natural or butadiene-styrene general purpose synthetic rubber to give it excellent SP properties. Use PA 80 in higher ratios for those special jobs.

(Left: section of extrusion magnified.)

. . . gasket for spin drier extruded from SP rubber. Manufacturers: P. B. Cow & Co. Ltd.

SP rubber is obtainable in No. 1 qualities as SP RSS, SP crepe, SP air-dried sheet, and in the off grades as SP brown crepe.

SP rubbers and PA 80 rubber are produced on far eastern estates under license from the Rubber Research Institute of Malaya. PA 80 is marketed in the form of 100-lb. blocks wrapped in polythene and packed in multiwall paper bags for ease of handling and good stacking in warehouse and factory.

For further information on SP rubber and PA 80 just drop us a line.

NATURAL RUBBER — A PRODUCT OF NATURE plus SCIENCE

TECHNICAL SERVICE DIVISION

NATURAL RUBBER BUREAU

1108 16th Street, N.W. WASHINGTON 6, D.C.

Sales Offices in: Chicago • Boston • Akron • Atlanta • Houston • Los Angeles • San Francisco • Toronto

CARBON BLACK WHERE YOU WANT IT

It makes little difference where in the world you are—from Bakersfield to Bordeaux—you are assured of "next door" carbon black service from Witco-Continental's international network of production facilities and sales offices.

Witco-Continental's unique system of "Unified Control" makes this possible. Wherever you are, your requirements are handled by one integrated world organization, to give you the benefits derived from continuous production and quality control, advanced packaging and shipping techniques —without waste motion.

And now, with capacity increased by fifty per cent, Witco-Continental's service is even more readily available —wherever you want it.

WITCO CHEMICAL COMPANY, Inc.
122 East 42nd Street • New York 17, N.Y.
CONTINENTAL CARBON COMPANY
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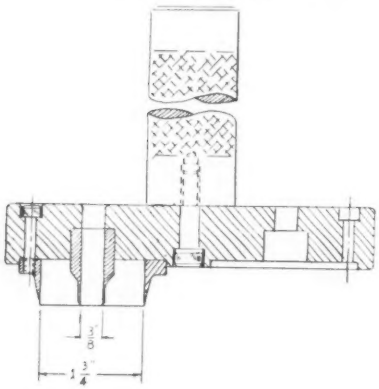
new equipment

(Continued from page 30)



Mooney specimen cutter

men cutting press and then be applied in a controlled manner without driving the blades deeply into a hard-backing material.

Electric Vibrator

The Cleveland Vibrator Co., Cleveland, O., has developed a new portable electric vibrator for moving materials from bins, hoppers, and trucks. Similar in mounting characteristics to railroad-car vibrators, the RC-5 LSRR attaches with a cast-iron wedge and bracket to permit dismounting. It can be lifted from its bracket mounting and moved wherever and whenever vibration is necessary.

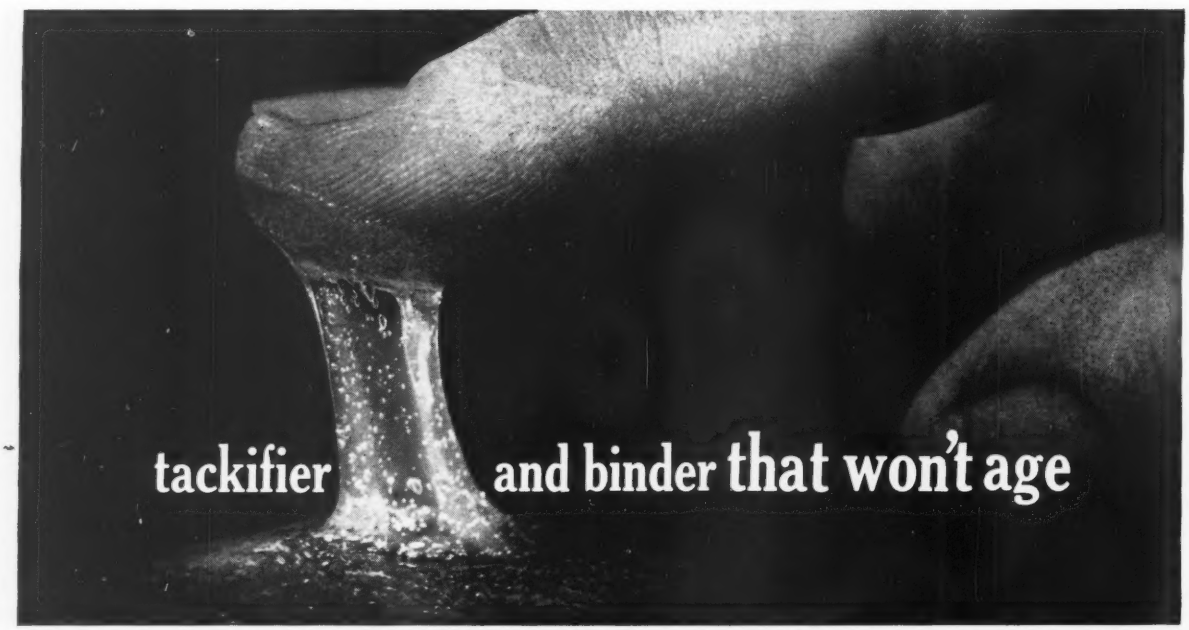
Compact Checkweigher

Model 1205-S, a new type of compact automatic high-speed checkweigher specially designed for installations where floor space is at a premium, has been introduced by Exact Weight Scale Co., Columbus, O. The checkweigher will automatically weigh, classify, and separate packages by correct weight, over weight, and under weight at speeds up to 200 per minute, depending on the accuracy requirements and product handling characteristics.

New Bucket Elevator

Bucketlift Jr., a low cost, compact bucket elevator designed for simplified, automatic loading of injection molding or extruding machine hoppers, has been introduced by M-H Standard Corp., Jersey City, N. J.

At floor level, powdered or granular material is loaded into the elevator's inlet hopper which is 25½ inches above the floor. The material is then automatically conveyed to the height of the elevator and dumped into the hopper of the molding machine.



POLYISOBUTYLENE DISPERSION 108. A stable, aqueous, unloaded dispersion of Vistanex®. Yields a clear, flexible, tacky film on drying. *Film will not age and is inert to attack by oxygen, ozone and chemicals* because polyisobutylene is almost completely saturated (has only terminal unsaturation). Dispersion 108 is compatible with natural and synthetic latices.

Use this exclusive Miller-Stephenson product:

- To increase tack of natural and synthetic latices
- In pressure sensitive adhesives (for tapes, etc.)
- As a tackifier, binder or modifier for cellulose, textile and leather fibers; powders; emulsions of asphalts, resins, waxes, rubbers.

Vistanex®, EPON® and VIBRIN® are registered trademarks

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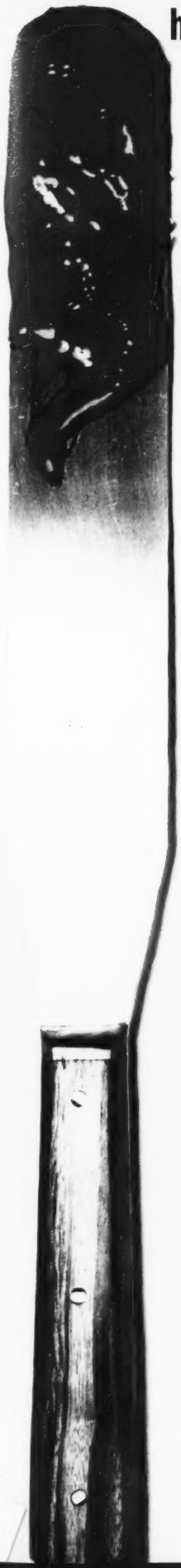
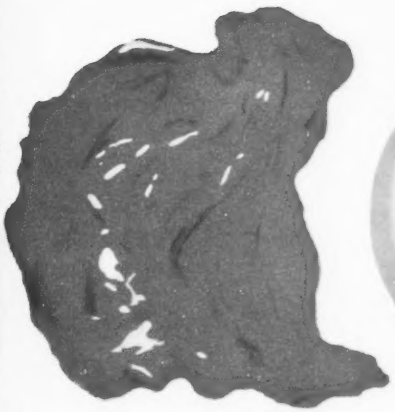
high tinctorial strength / excellent light fastness





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PERMANENT VIOLET TONER 49-6001

The inherent properties of this high-quality pigment recommend it for profitable utilization in many industries—printing ink, paint, enamel, lacquer, plastics, paper, and rubber.

Excellent fastness to light, high tinting strength, nonbleeding characteristics in vehicles and solvents, suitable dielectric properties—some of the outstanding and dependable qualities of Permanent Violet Toner 49-6001.

To meet diverse industrial requirements, Permanent Violet Toner 49-6001 is also supplied as—

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A Supra Paste 49-6016 (anionic)
N Paste 49-6027 (nonionic)
D 49-6034 (DOP)
M 49-6054 (medium soya alkyd)

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CLIMCO PROCESSING means
perfect separation for cutting operations

Nothing beats perfection, but Climco Processing will match it every time! Here's how you can avoid production headaches, save time at the bias cutter and cutting table – use Climco Liners that can be readily peeled from stock without sticking. Since 1922, the rubber industry has depended on Climco for superior separation, consistent quality and reliable delivery.

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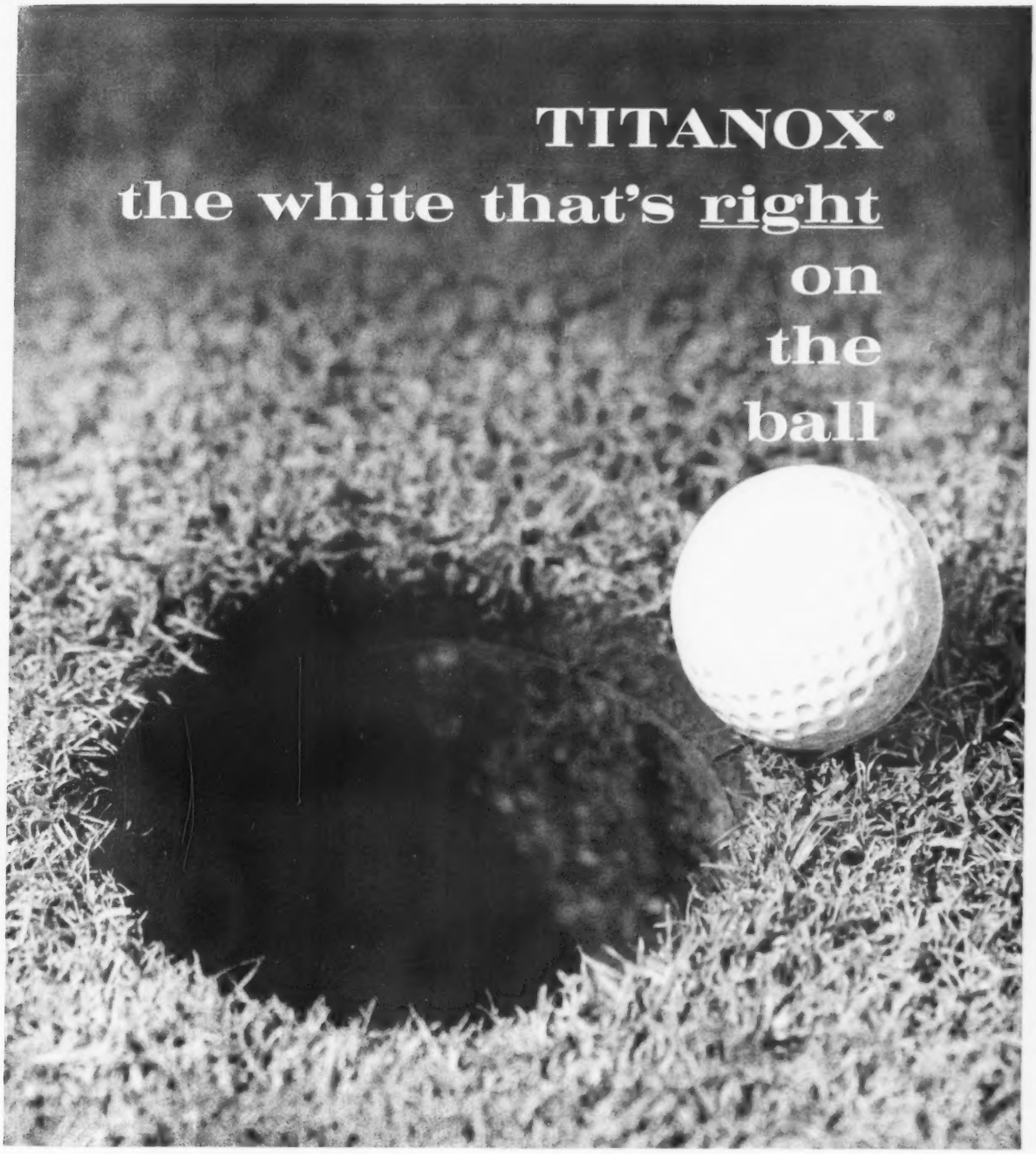
Send for the complete story today on Climco Processing.

CLIMCO

PROCESSED LINERS AND LINERETTE INTERLEAVING PAPER



To give their products outstanding visibility on the fairway and at the sales counter, golf-ball manufacturers rely, among other things, on an unbeatable threesome that includes the right compounding ingredients, the right vulcanizing conditions and the right TITANOX pigments.

These white titanium dioxide pigments are ideal for whitening and brightening golf balls—from the raw material used for cover stock to the final bright coating applied to the finished ball.

As it is with golf balls, so it is with a wide range of other rubber and plastic products—there's a TITANOX white pigment to do the job efficiently. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y. In Canada: Canadian Titanium Pigments Ltd., Montreal.

TITANIUM PIGMENT CORPORATION
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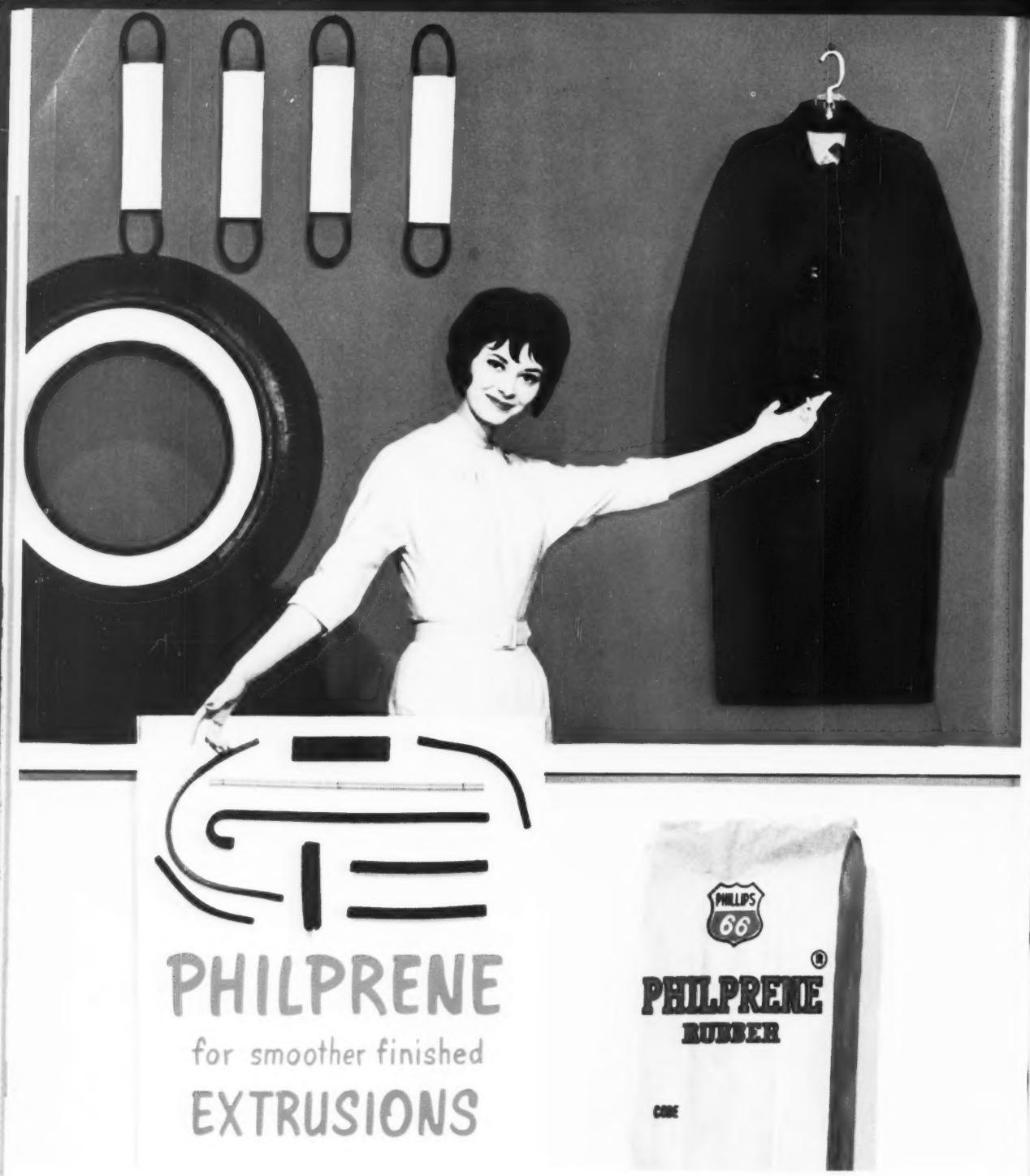

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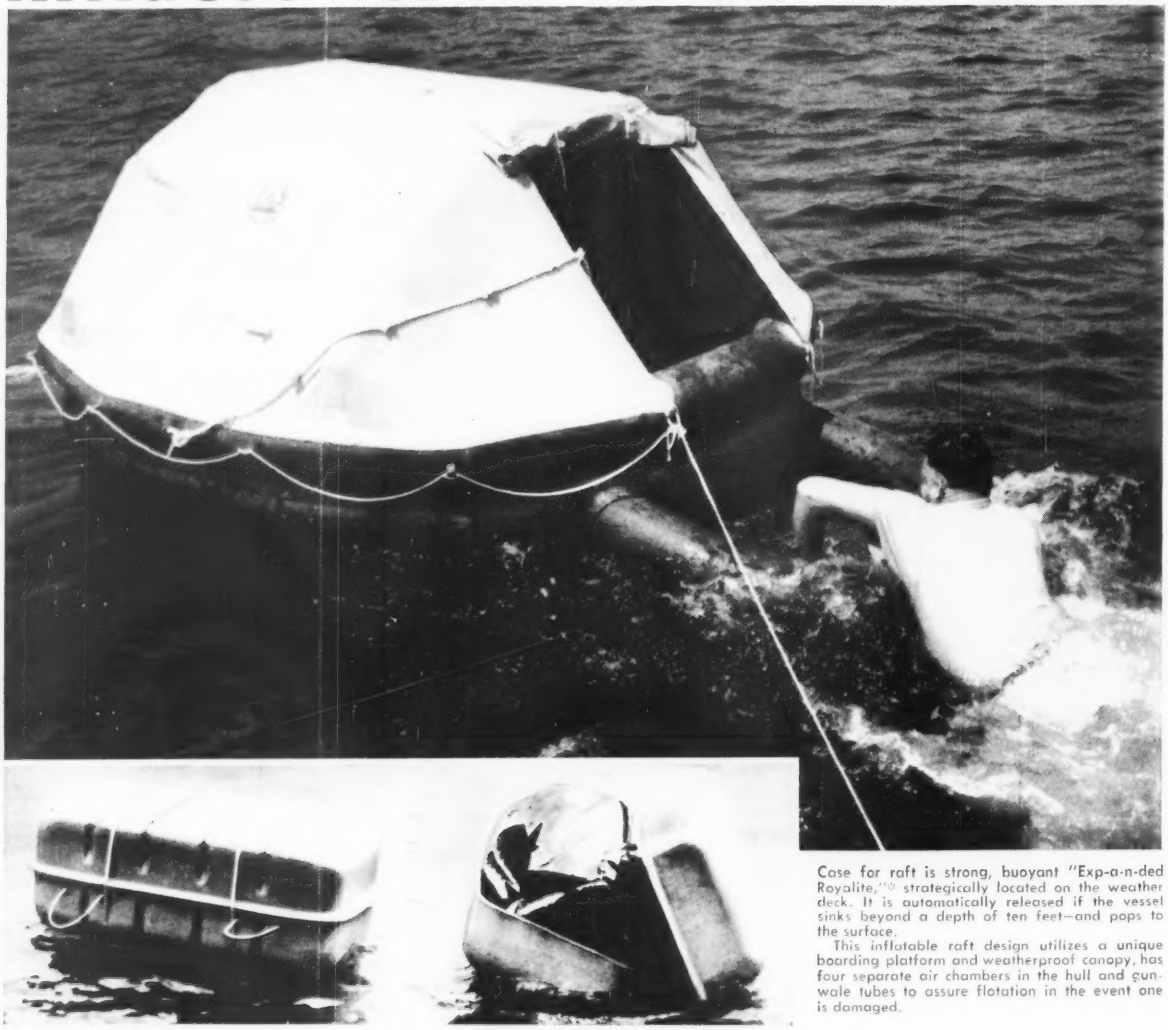
Philprene PHILLIPS 66

PHILLIPS CHEMICAL COMPANY, Rubber Chemicals Sales Division, 318 Water St., Akron 8, Ohio; **District Offices:** Chicago, Dallas, Providence and Trenton; **West Coast:** Harwick Standard Chemical Company, Los Angeles, California; **Export Sales:** Phillips Petroleum International Corporation, Sumatrastrasse 27, Zurich 6, Switzerland; Distributors of Phillips Chemical Company Products: 80 Broadway, N. Y. 5, N. Y.

*A trademark

New 15-man fabric life raft inflates itself in 30 seconds



Case for raft is strong, buoyant "Exp-a-n-ded Royalite,"* strategically located on the weather deck. It is automatically released if the vessel sinks beyond a depth of ten feet—and pops to the surface.

This inflatable raft design utilizes a unique boarding platform and weatherproof canopy, has four separate air chambers in the hull and gunwale tubes to assure flotation in the event one is damaged.

All you do is throw a plastic case overboard. When a lanyard has played out, the case opens—and CO_2 cylinders automatically inflate a raft that holds up to 15 passengers! Among its notable features: a platform that simplifies boarding and a canopy for protection from wind, rain and extreme temperatures.

A product of United States Rubber Company, this raft is made of nylon fabric from Wellington Sears. Coated with neoprene and vulcanized, the strong, light fabric assures long life in both extended storage and service.

This new development in sea rescue has been used for several years by inland shippers, towing companies and yacht owners. Recently given the official approval of the U. S. Coast Guard, it will soon be supplementing lifeboats on many classes of passenger and cargo vessels.

Countless fine companies rely on Wellington Sears to engineer fabrics for specific jobs. Our long experience and extensive research facilities assure top performance, whatever the requirements. Write for assistance and our illustrated booklet, "Fabrics Plus," Dept. H-6.

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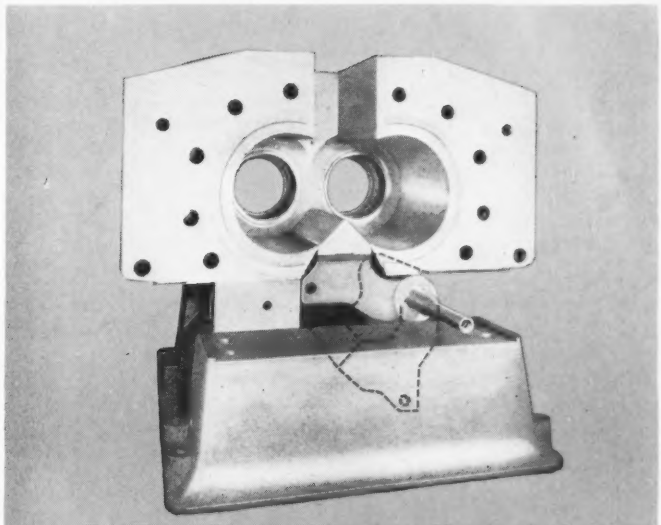


The hydraulically operated drop door is hinged so that its tapered edge swings up to make line contact with the mixing chamber.

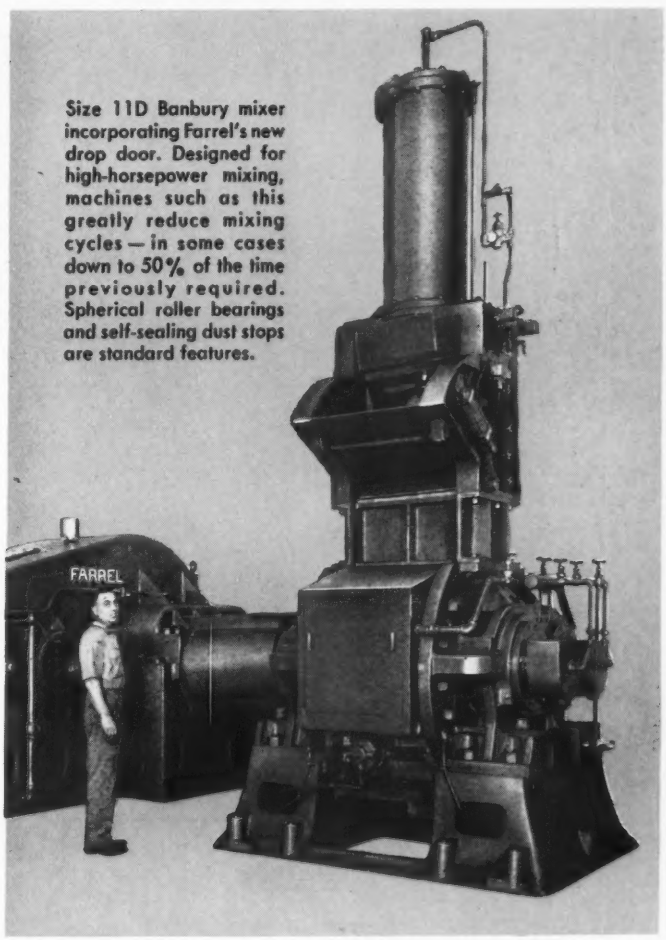
How a drop door for your Banbury pays for itself in less than a year

When you order a new body for your Banbury® mixer, you will find it profitable to convert to the new drop-door type. Reports from customers indicate a growing preference for this design based on its greater operational economy.

Experience has shown that the higher initial cost of a drop-door body is returned in six months to a year. This is accomplished by an appreciable reduction in cycle time due to the practically instantaneous action of the drop door and by the savings in material through the elimination of tail leakage and waste. Labor costs for cleanup are also reduced or eliminated entirely.

Drop-door bodies can be adapted to existing Banburys with little difficulty. They come with cored or spray sides to meet any processing need.

Bulletin 207 describes this development in detail. Send for a copy today.



Size 11D Banbury mixer incorporating Farrel's new drop door. Designed for high-horsepower mixing, machines such as this greatly reduce mixing cycles — in some cases down to 50% of the time previously required. Spherical roller bearings and self-sealing dust stops are standard features.

FARREL-BIRMINGHAM COMPANY, INC.
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FARREL®

FB-1219

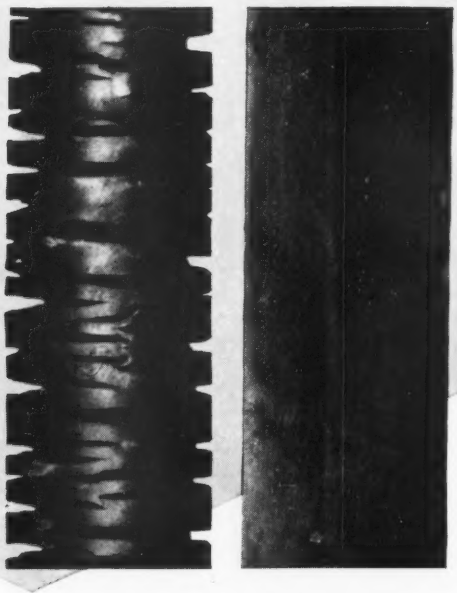
how to vastly increase the useful life of rubber...

Effect of Curing System on Antiozonant Retention in SBR Stocks after Vulcanization

(All contain 3.0 phr UOP 88; 40.0 phr HAF black)

Compound	Accelerator	Sulfur, phr	% Extractable Antiozonant
1082....	2.0 phr benzothiazyl disulfide	2.0	66.4
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1087....	None	2.0	~100.0
1088....	1.0 phr benzothiazyl disulfide	3.0	74.6
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1089....	1.0 phr benzothiazyl disulfide	1.0	88.6
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1084....	1.0 phr N-cyclohexyl-2-benzothiazole sulfenamide	—	—
1093....	1.0 phr diphenylguanidine	2.0	~18.0
1085....	2.0 phr tetramethylthiuram disulfide	—	35.0
1090....	4.0 phr tetramethylthiuram disulfide	—	12.9

The SBR specimens below were exposed to ozone at 100°F with 20 percent elongation for 52 hr. at 33 pphm ozone, then 187 hr. at 63 pphm ozone.



Carbon black—HAF (high abrasion furnace), Curing system—4 phr tetramethylthiuram disulfide; Hours to first crack—7 to 23.

Carbon black—HAF (high abrasion furnace), Curing system—2 phr sulfur, 1 phr N-cyclohexyl-2-benzothiazole sulfenamide. No cracks in 239 hr.

CONSIDER THE EFFECT OF YOUR CURING SYSTEM ON THE EFFECTIVENESS OF A CHEMICAL ANTIOZONANT

In compounding rubber, there are several things which are important in assuring maximum crack-free life. First, you must use a potent antiozonant like UOP 88 or 288. Next, consider what a vast difference in effectiveness can be realized by your *curing system.*

The right antiozonant used in correct proportion is of primary importance. Then, by using the proper accelerator, you can promote its maximum effectiveness, and thus contribute to maximum ozone protection.

Look at the two rubber test strips illustrated. Both were formulated with UOP 88 . . . but note how much more effectively the antiozonant worked when accompanied by this change in curing systems—a vast increase in resistance to cracking. The table above the test strips shows how the *proper* accelerator aids antiozonant effectiveness.

Help in achieving maximum effectiveness from UOP 88 or 288 antiozonants in your rubber formulations is available through UOP facilities and technical personnel. Just write or telephone our Products Department.

WHERE RESEARCH TODAY MEANS PROGRESS TOMORROW

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UOP ozone cabinets provide test conditions at a wide range of ozone concentrations.

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Part Two—LATEX COMPOUNDING INGREDIENTS

Part Three—NATURAL AND SYNTHETIC RUBBERS, LATICES, AND RECLAIMS

Part Four—NAMES AND ADDRESSES OF SUPPLIERS

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new products

"Multi-Color" Tires

The Goodyear Tire & Rubber Co., Akron, O., has announced new "Multi-Color" tires with bands of color on their white sidewalls.

The company reports that the tires in the "custom super cushion" line are being made available to the automotive industry and will also be offered to the tire replacement market on a premium basis as production schedules permit. Initially, they are being produced with bands of red or blue.

The color bands are made of a specially compounded rubber containing fadeproof inorganic dye, the manufacturer further states. The rubber is resistant to sun and weather and will clean as easily as a regular white sidewall.

Industrial Gloves

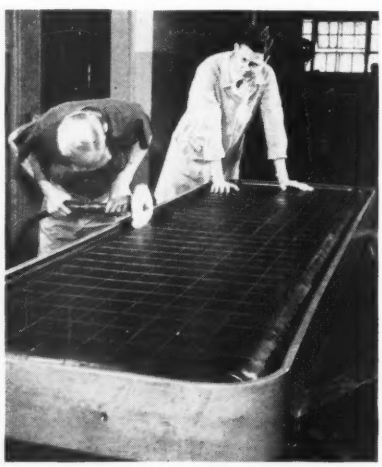
Wilson Rubber Co., Canton, O., is marketing Wil-Gard neoprene industrial gloves for industrial services requiring contact with oils, greases, petroleum solvents, and caustics. The manufacturer claims that these industrial gloves do not deteriorate from age or exposure to sunlight and that they provide excellent protection because they are completely free of allergens that often irritate sensitive skin. Available in two styles, 88-Smooth and 88-Firmhold, and in 11-inch lengths, the gloves are offered in medium-heavy weight, in sizes from 7 to 11.

"Duplex" Truck Tire

A single, wider truck tire that can take the place of the duals now used on trucks is being made by The Firestone Tire & Rubber Co., Akron, O. The advantages of the new "Duplex" tire include provision for wider spring spacing to improve vehicle stability, high carrying capacity, which could lead to greater front axle loads, and the elimination of fire hazards originating from driving on duals when one of the tires is flat. At present, the tire will be available in four sizes: 15-19.5, 18-19.5, 18-22.5, and 23-23.5.

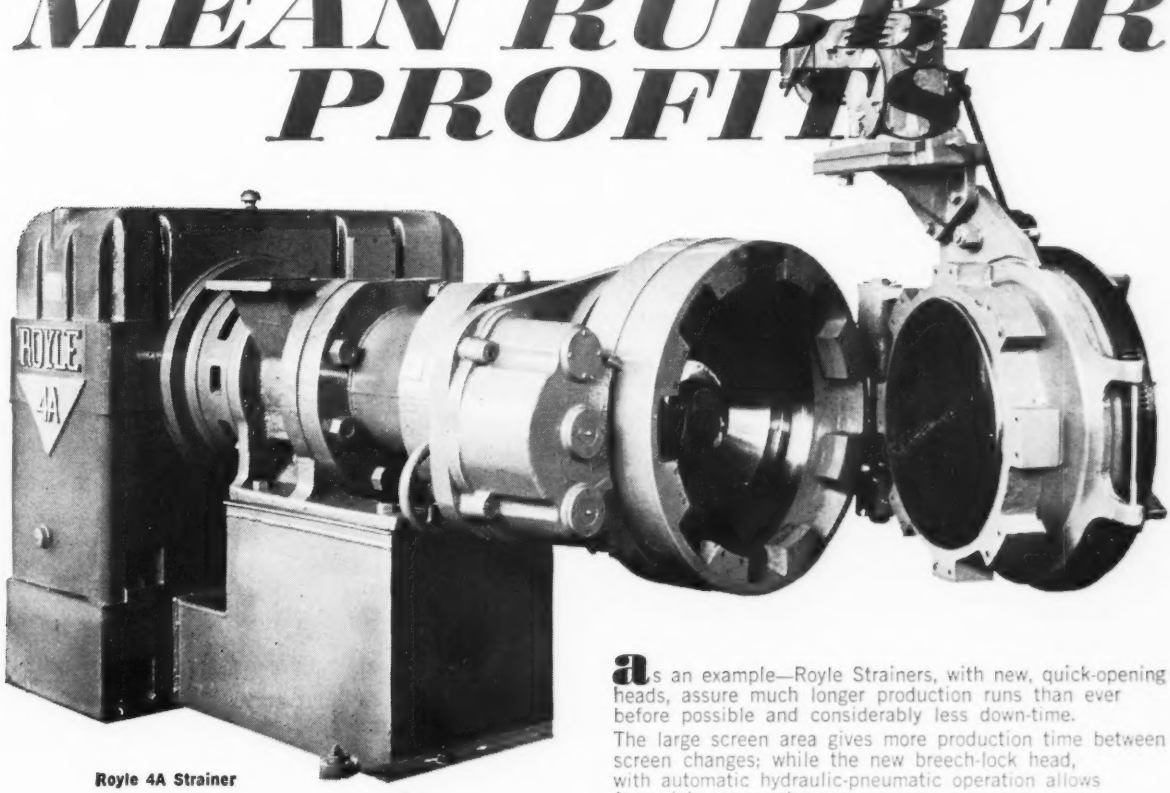
Rubber Forming Pads

The General Tire & Rubber Co., Akron, O., has developed rubber forming pads for use in large metal forming presses. Actuated by hydraulic pressure applied through a rubber diaphragm, the pads are said to offer an improved method for forming metal parts used mainly in the aircraft industry. The manufacturer reports that use of these two rubber components gives added control and accuracy during forming, requiring little or no hand-finishing of the formed part and speeding up the overall process since many parts can be formed at one time.



1400-pound rubber pad for metal forming

ROYLE STRAINERS MEAN RUBBER PROFITS



Royle 4A Strainer

As an example—Royle Strainers, with new, quick-opening heads, assure much longer production runs than ever before possible and considerably less down-time.

The large screen area gives more production time between screen changes; while the new breech-lock head, with automatic hydraulic-pneumatic operation allows for quick screen changes.

There are many other practical advantages built right in to Royle Extruders, for instance:

Heavy Duty Gear Case—with self-lubricating, opposed helical gears that were Royle designed and engineered specifically for strainer operations.

Powered Cut-Off Knife—with either rotary or up-and-down motion and adjustable cycling to give variable length products.

Longer L/D Ratios—allow mixing operations to be performed in the extruder. This gives a continuous and, hence, more economical mixing method than other operations.

Write today for complete Royle Strainer information. There is no obligation on your part.

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Pioneered the Continuous Extrusion Process in 1880

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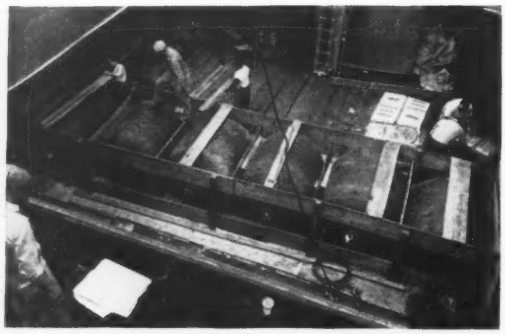

Ten tons of rubber are uncrated at a Jersey City, N. J., pier in an experimental shipment of latex in 500-gallon rubber drums. United States Rubber Co., developer of the collapsible containers called Sealdrums, is making the test shipments from its plantations in Malaya. Latex ordinarily is shipped in disposable steel drums or in 150,000-gallon tanks found only on special-equipment vessels. These rubber drums would permit more flexible shipment schedules because they could be shipped on almost any type of vessel

This tire-like object being X-rayed for flaws at B. F. Goodrich Aviation Products, Akron, O., is a heat-resistant insulator for missiles of the Polaris class, which protects the missile motor case during the last few seconds of firing. For this project Goodrich has developed new synthetic rubber compounds that resist high temperatures

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Roebling Tire Bead Wire: *Packaged for Maximum Benefit*

The problems eliminated by this unique reel-less core packaging system are manifold. Loads are palletized two cores per pallet and may be stacked two or three high. This, plus the fact that you need not accumulate empty reels means storage space requirements are cut to *less than half*. You do away with all freight and handling costs on reels, the bother and expense of "bookkeeping" returnable reels, and the freezing of money in reel deposits.

This is typical of Roebling's advanced packaging methods—that makes handling Roebling high-quality wire so much easier. For details on this efficient Roebling Tire Bead Wire packaging method, or information on other types of Roebling wire, write Roebling's, Wire and Cold Rolled Steel Products Division, Trenton 2, New Jersey.

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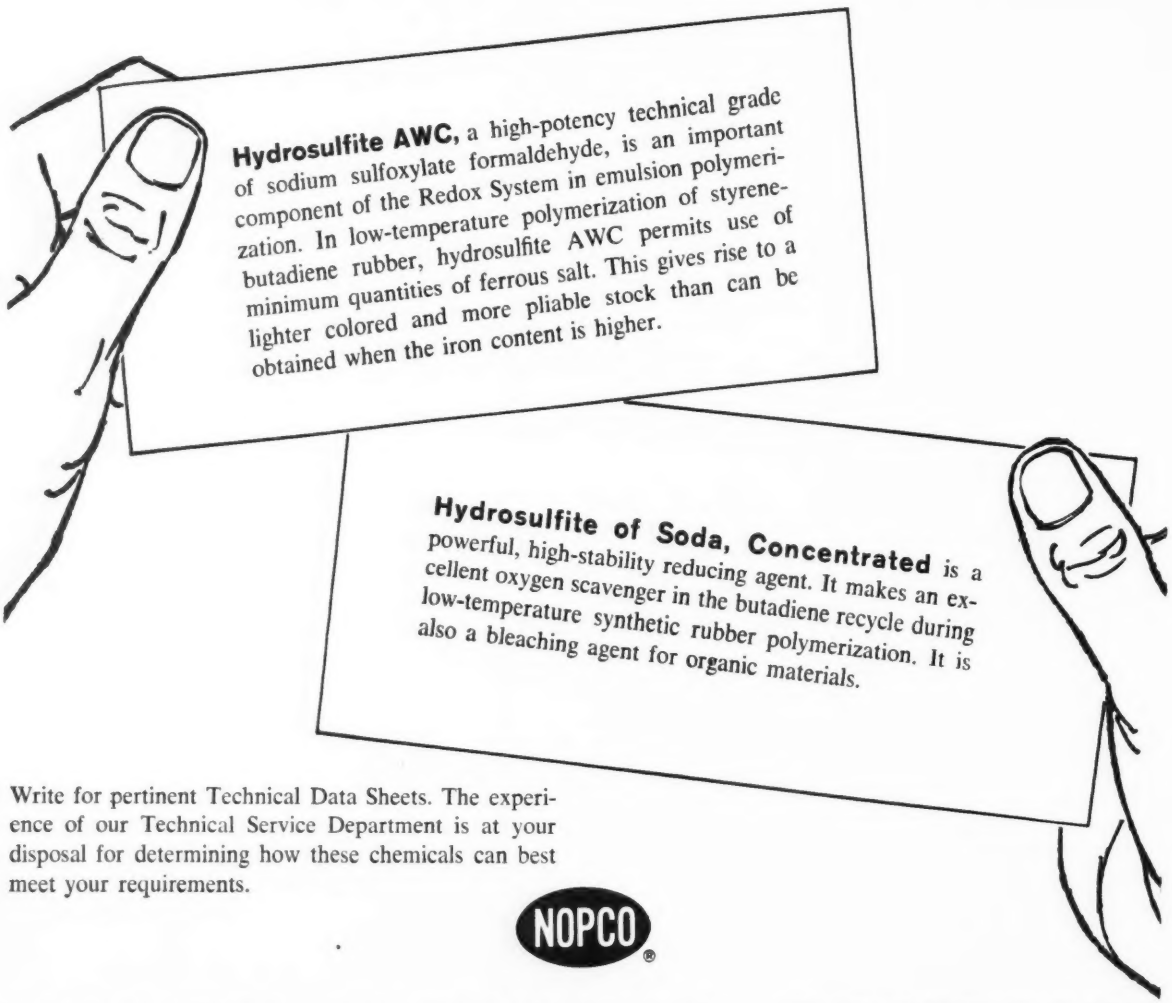
HIGH-POTENCY HIGH-PURITY POLYMERIZATION AGENTS



Hydrosulfite AWC, a high-potency technical grade of sodium sulfoxylate formaldehyde, is an important component of the Redox System in emulsion polymerization. In low-temperature polymerization of styrene-butadiene rubber, hydrosulfite AWC permits use of minimum quantities of ferrous salt. This gives rise to a lighter colored and more pliable stock than can be obtained when the iron content is higher.

Hydrosulfite of Soda, Concentrated is a powerful, high-stability reducing agent. It makes an excellent oxygen scavenger in the butadiene recycle during low-temperature synthetic rubber polymerization. It is also a bleaching agent for organic materials.

Write for pertinent Technical Data Sheets. The experience of our Technical Service Department is at your disposal for determining how these chemicals can best meet your requirements.

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HARCHEM SEBACATE PLASTICIZERS

Keep your vinyl products from showing their age in use and they'll keep building good will and good volume for you.
Harchem Sebacate Plasticizers give vinyls built-in resistance to heat, cold, water or physical abuse.
Harchem offers four Harflex Sebacic Acid Esters. Check the list below for the one best suited to fight aging, weathering and wear for you.

will do it!

Plasticizer	Specific Gravity 25°/25°C ±.003	Viscosity 25°C, cps	Compatible With	Outstanding Characteristics
Dibenzyl Sebacate	1.055	21-22	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers	Excellent Solvation, Very Low Volatility, Permanence, Good Electricals, Low Temp. Flexibility
Dibutyl Sebacate	0.935	7.9	Vinyl Resins, Cellulose Acetobutyrate, Synthetic Rubbers, Rubber Hydrochloride, Polymethyl Methacrylate	Low Temp. Flexibility, Excellent Aging Qualities, Non-Toxic
Dimethyl Sebacate	0.986*	3.54 @30°C	Vinyl Resins, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate, Acrylic Resins	High Solvency and Efficiency, Wide Compatibility, Concentrated Source of Sebacyl Radical
Dioctyl Sebacate	0.913	17.4	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate	Excellent Low Temp. Flexibility, Low Volatility, Excellent Soapy Water Resistance, Good Electricals

*30°/20°C

Write for Bulletin or Consult CHEMICAL MATERIALS CATALOG Pages 159-161

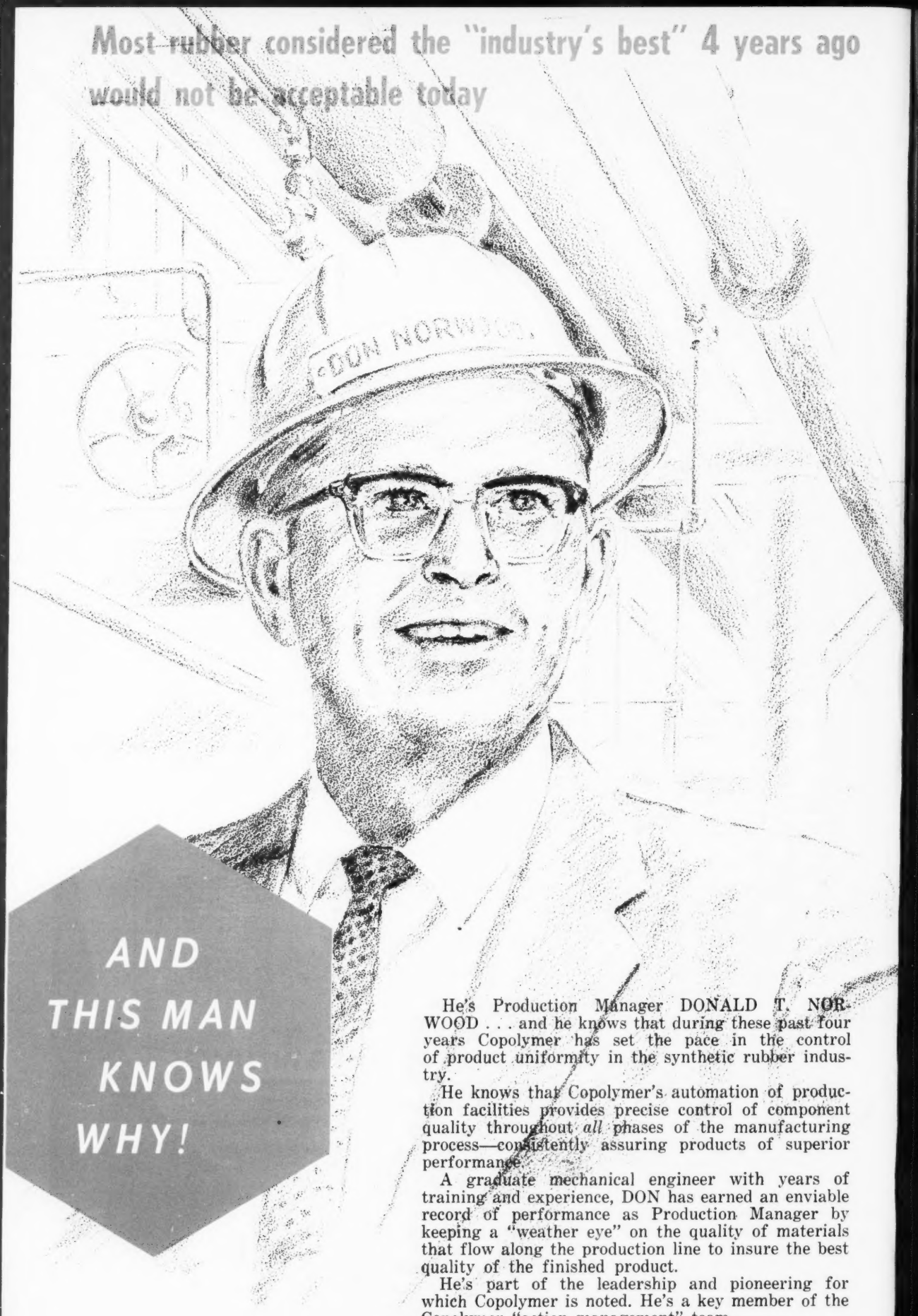
WALLACE & TIERNAN INC.

HARCHEM
THE KEY TO BETTER PLASTICS

HARCHEM DIVISION | **25 Main Street**
Belleville 9, New Jersey

IN CANADA: HARCHEM LIMITED, TORONTO

Most rubber considered the "industry's best" 4 years ago would not be acceptable today



AND THIS MAN KNOWS WHY!

He's Production Manager DONALD T. NORWOOD . . . and he knows that during these past four years Copolymer has set the pace in the control of product uniformity in the synthetic rubber industry.

He knows that Copolymer's automation of production facilities provides precise control of component quality throughout *all* phases of the manufacturing process—consistently assuring products of superior performance.

A graduate mechanical engineer with years of training and experience, DON has earned an enviable record of performance as Production Manager by keeping a "weather eye" on the quality of materials that flow along the production line to insure the best quality of the finished product.

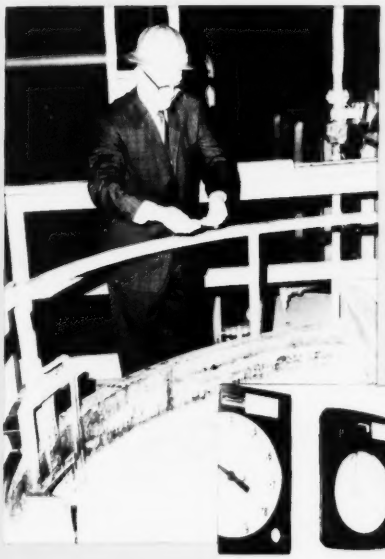
He's part of the leadership and pioneering for which Copolymer is noted. He's a key member of the Copolymer "action management" team.

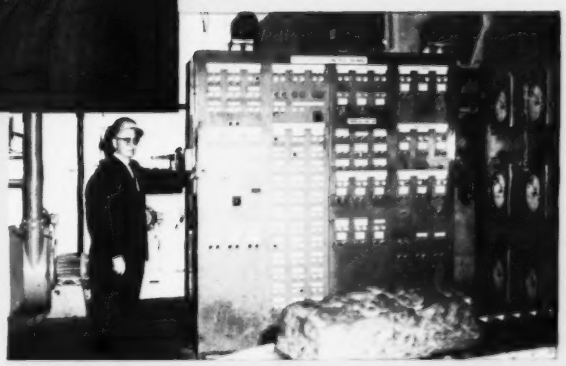
Some of the best rubber in the industry was produced at Copolymer four years ago. Yet, improvements have been so vast, that most of those compounds would not be acceptable by Copolymer standards today!

THESE REJECTED BALES ARE ONE EXAMPLE.

These are bales of black masterbatch that Copolymer customers never see. Their moisture content is in excess of the Copolymer standard, YET STILL WITHIN INDUSTRY TOLERANCE.

Copolymer's production department utilizes a method to inspect EACH BALE INDIVIDUALLY for moisture content. This allows Copolymer to achieve a degree of control which is impossible through ordinary laboratory controls which consider only portions of a given production run.





Automation of production facilities during the last several years has meant automatic control of materials metered into the manufacturing process —and greater control of finished product quality. The precise, efficient operation of Copolymer's production facilities is the responsibility of Production Manager Don Norwood.

UNIFORMITY is the result of extremely close control of all components which go into Copolymer products, the broad understanding of operational variables, solution make-up, coagulation and drying conditions.

Your Copolymer representative can help you with a recommendation of the best Copolymer product for your manufacturing use. Call him today.

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TIRE FABRIC PROCESSING EQUIPMENT

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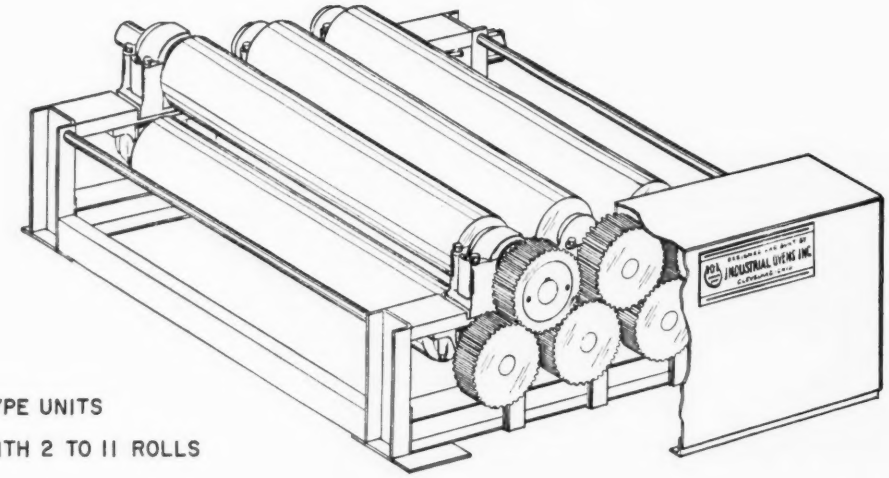

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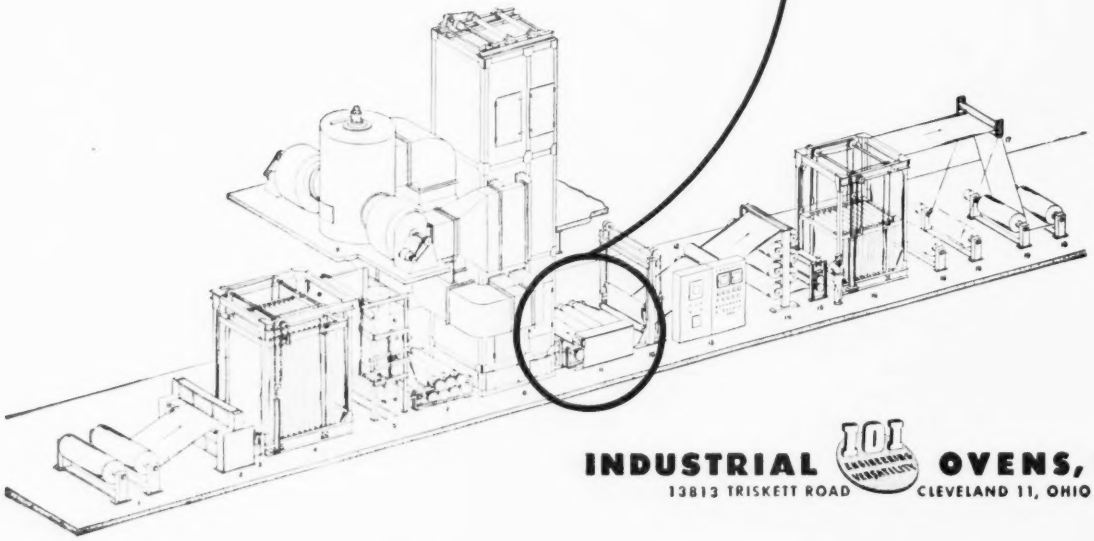

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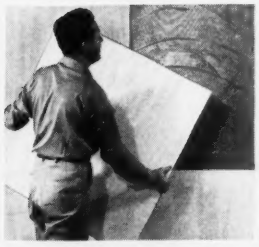
Better... from VELSICOL

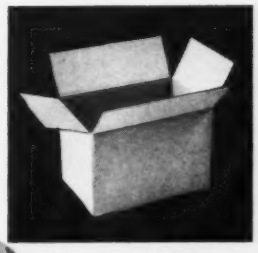
Adhesive recipes containing Velsicol's hydrocarbon resins are TOPS FOR TACK



WALL & FLOOR TILE
Mastics for floor and wall tile or sheets, bond better with Velsicol resins in the mix.

LOW OXYGEN SUSCEPTIBILITY OF VELSICOL HYDROCARBON RESINS KEEPS ADHESIVE PRODUCTS TACKY!

Velsicol hydrocarbon resins in combination with synthetic elastomers improve adhesives by providing excellent initial grab and longer lasting tackiness. Oxygen take-up is lower so aging and drying is retarded appreciably. The result is adhesive products with longer life at lower cost. PROVIDES *BETTER* BONDING—*BETTER* CHEMICAL AND WATER RESISTANCE!



PAPER
Velsicol hydrocarbons combined with Neoprene make excellent adhesive for Kraft to Kraft bonding.

TAPE
Plastic and cellophane tapes have longer life and tack retention when Velsicol resins are used in Styrene Butadiene recipes.

LEATHER
Shoe last cement for manufacture and repair is improved and a 100% tearing bond secured when Velsicol hydrocarbon resins are used with nitrile rubber.

VELSICOL RESINS ARE HIGH IN QUALITY . . . STABLE IN PRICE . . . CONSTANT IN AVAILABILITY!

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☐ Please have a Velsicol representative call.

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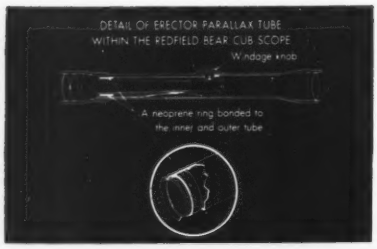
With Eastman 910 Adhesive...

Strong neoprene-to-aluminum bonds in 2 minutes

Take two aluminum tubes, one smaller than the other. Put one inside the other. At one end only, bond a neoprene ring between the two tubes. Got it? How long did it take you? Ames Rubber Company, of Hamburg, New Jersey, does it in two minutes when assembling the Redfield Gunsight Company's "Bear Cub Scope," a precision telescopic rifle sight. Ames uses Eastman 910 Adhesive. Over 25,000 units have been produced with no reports of bond failure.

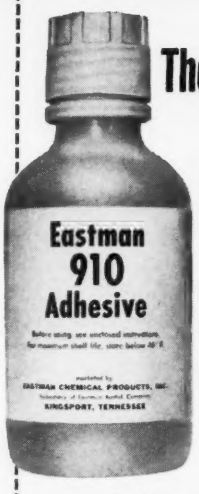
Eastman 910 Adhesive will form bonds with almost any kind of material...fast, too.

Skeptical? Then send $5 for a trial kit and try it on *your* toughest job. Kits and further information are available from Armstrong Cork Company, Industrial Adhesives Division, 9104 Inland Road, Lancaster, Pa., or Eastman Chemical Products, Inc., Dept. R-4, Kingsport, Tennessee.


DETAIL OF ERECTOR PARALLAX TUBE
WITHIN THE REDFIELD BEAR CUB SCOPE
Windage knob
A neoprene ring bonded to
the inner and outer tube

Here are the types of bonds that can be made with Eastman 910 Adhesive

Among the stronger: *Natural rubber, SBR, Buna N, most types of neoprene, steel, aluminum, brass, copper, most woods, vinyls, phenolics, cellulosics, polyesters, polyurethanes,* and *nylon.* Among the weaker: *polystyrene, polyethylene* and *fluoro-hydrocarbon plastics* (sheer strengths up to 150 lbs./in.^{2}).

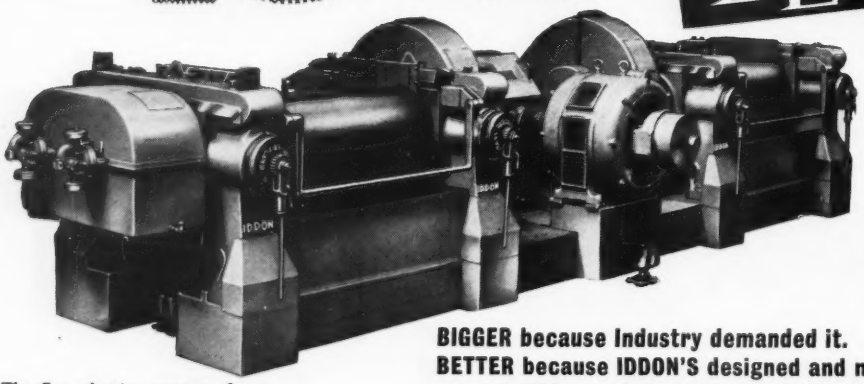


There is no adhesive like Eastman 910 Adhesive

Sets fast—Makes firm bonds in seconds to minutes.
Versatile—Joins virtually any combination of materials.
High strength—Up to 5,000 lbs./in.^{2} depending on the materials being bonded .
Ready to use—No catalyst or mixing necessary.
Cures at room temperature—No heat required to initiate or accelerate setting.
Contact pressure sufficient.
Low shrinkage—Virtually no shrinkage on setting as neither solvent nor heat is used.
Goes far—One-pound package contains about 14,000 one-drop applications.
The use of Eastman 910 Adhesive is not suggested at temperatures above 175°F., or in the presence of extreme moisture for prolonged periods.

See Sweet's 1961 Product Design File 10d/Ea.

BIGGER and BETTER



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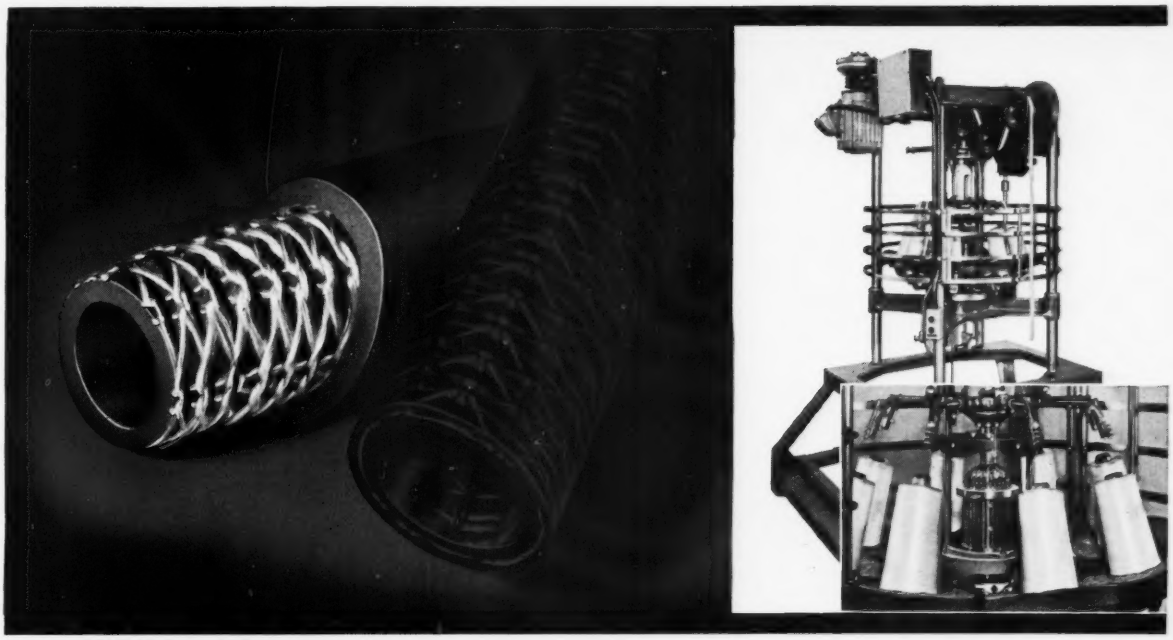

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technical books

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BOOK REVIEWS

"Rubber and Railways in the Nineteenth Century." P. L. Payne. Cloth, 5¾ by 8¾ inches. 216 pages. Liverpool University Press, Bedford House, 75 Bedford St. South, Liverpool 7, England. Price, 30 s.

Essentially this work on the firm of George Spencer & Co., which merged with the firm of Stephen Moulton & Co. in 1891, is a companion volume to an earlier work published by Liverpool University Press, a history of the Moulton company titled, "The Rise of the British Rubber Industry during the Nineteenth Century."

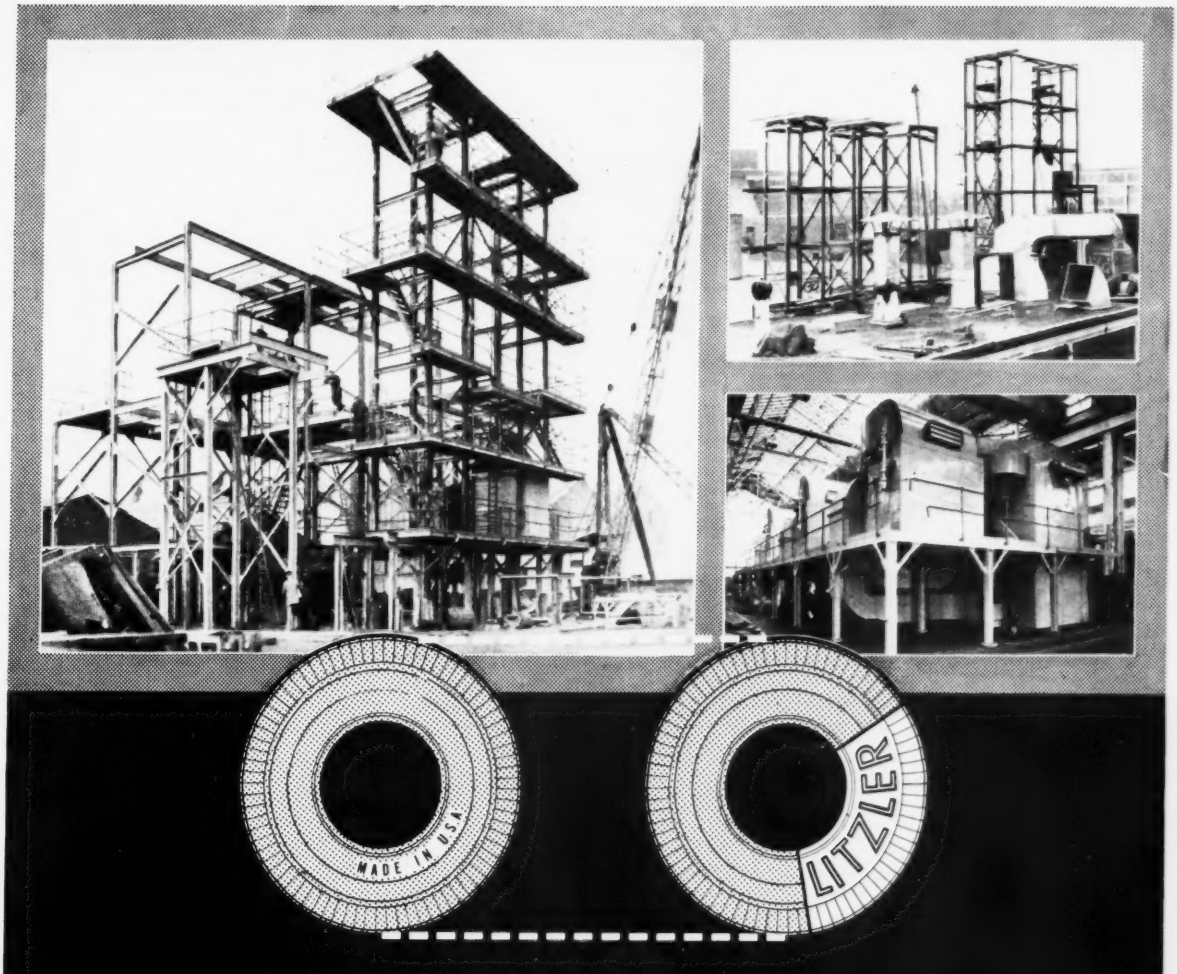
George Spencer devised new rubber springing systems, vacuum hoses, valves, washers, window seals for use on British railways, had the parts made to his specifications by rubber producers and ironmasters, assembled the parts, and sold them to the railways. In a large sense he was one of the first of the modern manufacturing middlemen.

Mr. Payne, Colqhoun Lecturer in business history at the University of Glasgow, has done a definitive study on George Spencer & Co., based on the Spencer papers, a collection of patent specifications, legal agreements, patent specifications, and letters to and from parts manufacturers, agents, salesmen, consulting engineers, and railway officials. Although basically for the specialist in rubber industry history, "Rubber and Railways in the Nineteenth Century" casts considerable light on the problems of a British manufacturer in the last half of the Nineteenth Century.

"Kautschuk Handbuch." Volume II. Edited by Siegfried Bostrom. Published by Berliner Union G.m.b.H., Stuttgart, Germany. PVC cover, 6¼ by 9 inches, 568 pages, 361 illustrations.

In an irregular order of publication Volume III of Bostrom's four-volume Rubber Handbook, appeared first, followed by Volume I—both reviewed in the November, 1960, issue of Rubber World, (page 48). The material he covers is divided into five parts, and the present Volume II, comprises the final chapters—14 through 18—of Part 1, Volume I, concerned with raw material, as well as Part 2, covering processing techniques and machinery. The raw materials considered in the present volume are: polysulfide rubbers, silicone rubbers, polyurethanes and PVC, their preparation, properties, and applications; reclaims of natural rubber, butyl, Perbunan,

(*Continued on page 60*)



29.5% of existing United States tire cord fabric processing capacity is presently represented by new Litzler fabric treating lines currently under contract. Some are in design phases, others are under construction or undergoing final erection. Some will expand United States production, others are destined for the tire industry abroad, in both hemispheres. Each is a tribute to the capacity of Litzler engineers for truly "Sound Engineering for Tomorrow's Production".

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Further details are easily obtained by writing to:

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technical books

(*Continued from page 58*)

neoprene, silicones, and Vulcollans receive similar detailed treatment.

Part 2, consists of 11 chapters, of which four give details of the preparation and vulcanizing of compounds of natural rubber; hot and cold butadiene-styrene polymers, blends and stereospecific polymers; butadiene-acrylonitrile copolymers and blends; butyl rubber and latex. The next five chapters take up the use and effects of organic and inorganic compounding ingredients, plasticizers, extenders, pigments and other aids; the preparation and properties of cellulose hydrate fibers, wholly synthetic fibers (polyamide, polyester polypropylene and polyvinyl alcohol); the manufacture, properties, and application of tire cord. The final two chapters are devoted to machinery and auxiliary equipment.

Originally, it had been the intention to devote three chapters in this volume to accelerators, antiagers, and peptizers, respectively, but these could not be prepared in time and will be included in Volume IV. As in the earlier volumes, each chapter in the present book is accompanied by more or less extensive bibliographies.

NEW PUBLICATIONS

"Philprene Polymers." Phillips Chemical Co., rubber chemicals sales division, Akron, O. 50 pages.

"Modern Presses—Hydraulic." Bulletin P95. The French Oil Mill Machinery Co., Hydraulic Press Division, Piqua, O. 34 pages.

"**Win with . . . Delac-S,** a New Dustless Prill Form Delayed-Action Accelerator." Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. 2 pages.

"Special Coatings." S. C. Johnson & Son, Inc., Racine, Wis. 4 pages.

"Questions and Answers about Valving, the Heart of Any Reciprocating Compressor." Ingersoll-Rand Co., New York, N. Y. 44 pages.

"Hinged Steel Belt Conveyors." Catalog MF-100A. May-Fran Mfg. Co., Cleveland, O. 8 pages.

"Group CF Chempumps." Bulletin 1051-1. Fostoria Corp., Chempump Division, Huntingdon Valley, Pa. 2 pages.

"New Doctor Blades." Bulletin DB-61. John W. Bolton & Sons, Inc., Emerson Mfg. Co. Division, Lawrence, Mass. 4 pages.

"Series 156 Ball-Bearing Idlers." Bulletin 456-10. Webster Mfg., Inc., Tiffin, O. 4 pages.

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Many heel and sole manufacturers have already discovered that inexpensive RECLAIM rubber makes a better product, faster and at less cost, than virgin rubber.

They know shoe manufacturers benefit from the improved dimensional stability of RECLAIM. They themselves prefer RECLAIM because it offers them such advantages as:

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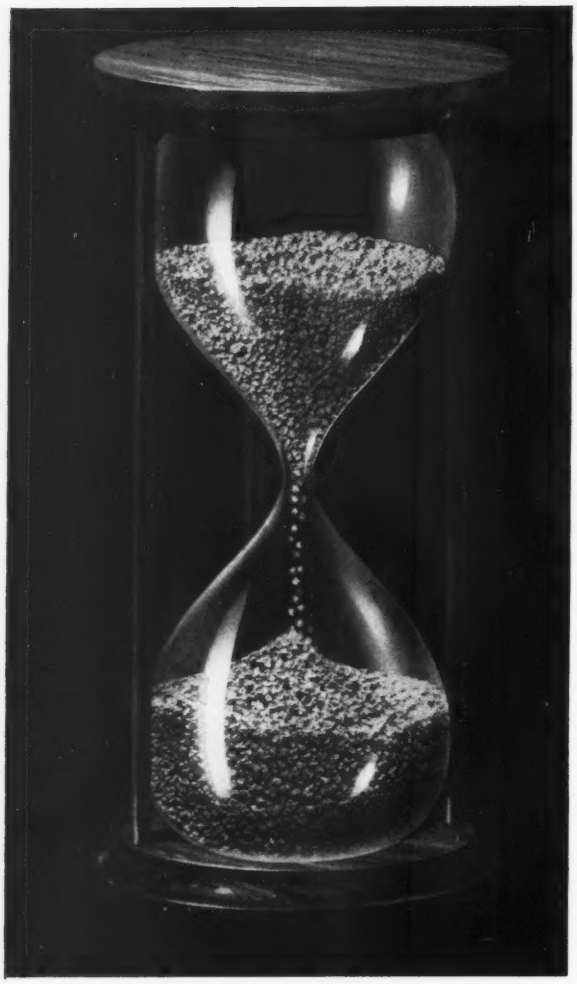
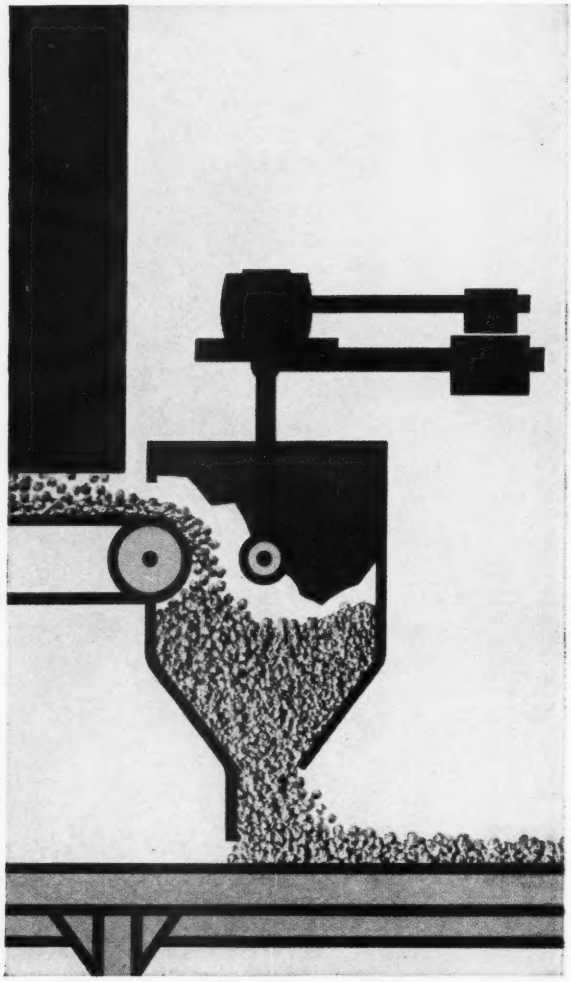
Naugatuck DELAC-S PRILLS





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*Chemical dictionary definition

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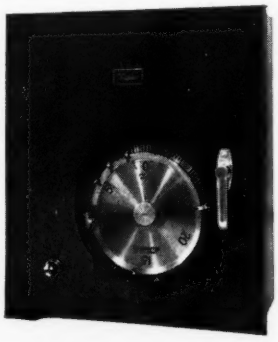

New FLEX-O-TIMER* Timed Program Controller gives you up to 12 pneumatic and/or electric functions; faster, easier setting of program trip pins; positive acting air valves with more than 3 times previous output capacity. Ideal for completely automatic timing of tire pressures or platen presses.

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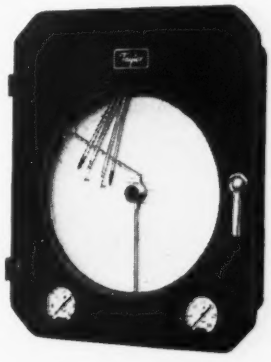

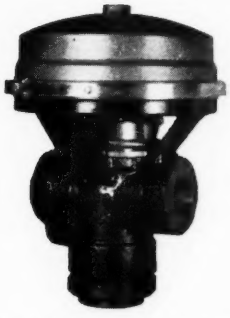

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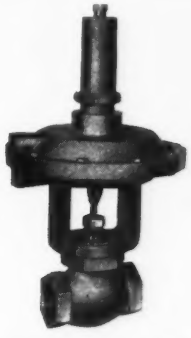

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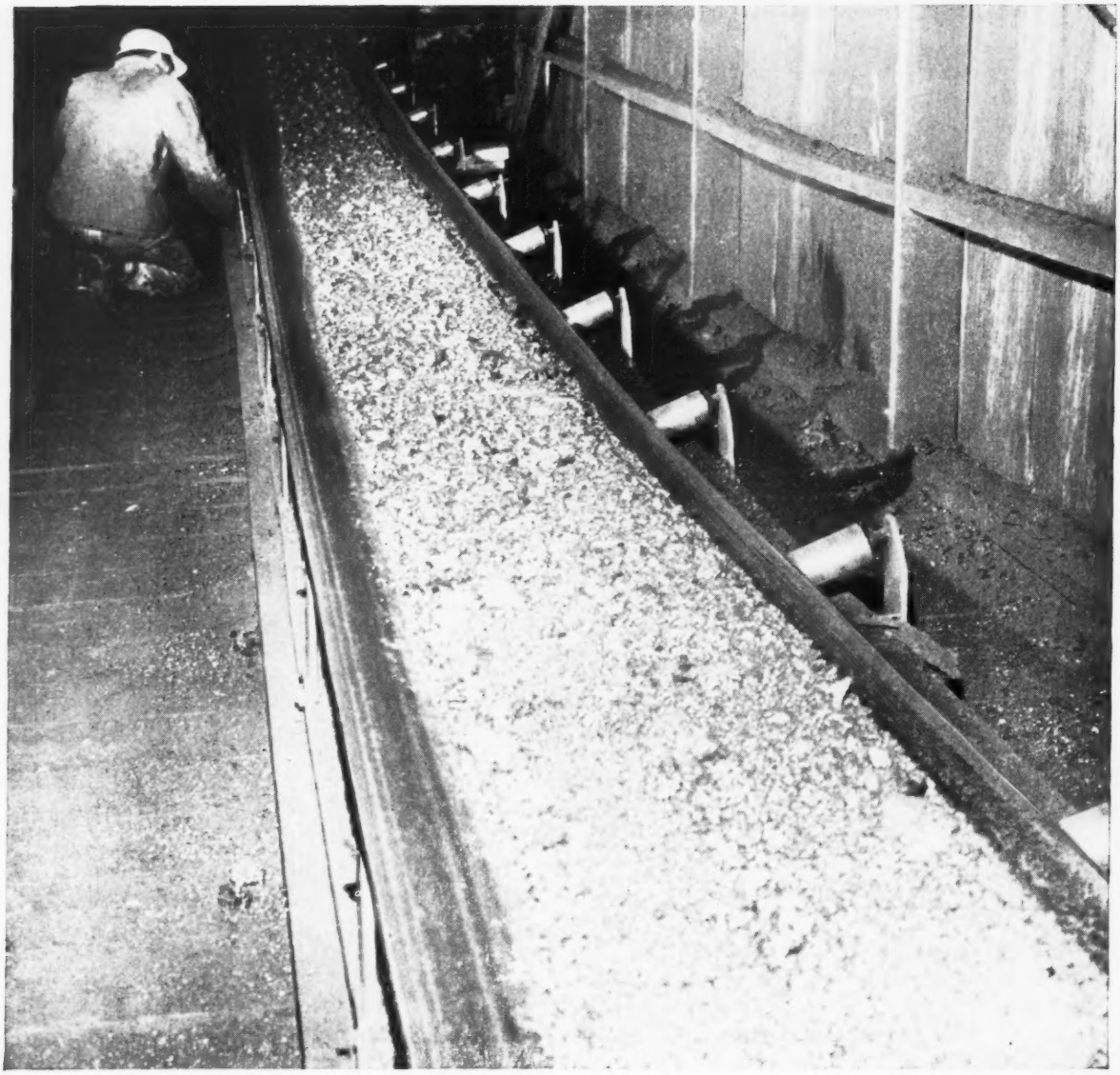

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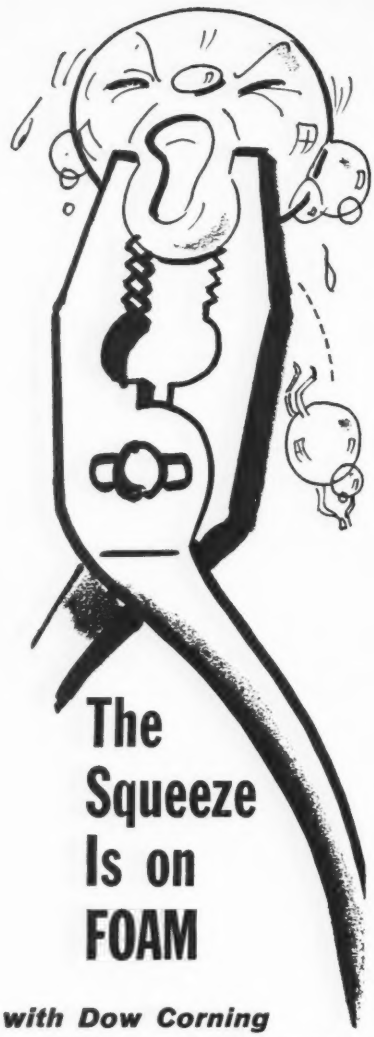

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June 13
Buffalo Rubber Group. Outing. Lancaster Country Club.

June 16
Akron Rubber Group. Outing. Firestone Country Club.
Boston Rubber Group. Outing. Andover Country Club. Andover, Mass.

June 23
Detroit Rubber & Plastics Group, Inc.

June 23-24
Southern Rubber Group. Buena Vista Hotel, Biloxi, Miss.

June 25-30
American Society for Testing Materials. National Meeting. Chalfonte-Haddon Hall, Atlantic City, N. J.

June 28-30
Committee D-11, ASTM. Atlantic City, N. J.

August 1
New York Rubber Group. Golf Outing. Scotch Plains and Echo Lake Country Clubs.

August 3-4
Chemical Institute of Canada. Canadian Chemical Conference and Exhibition. Queen Elizabeth Hotel, Montreal, P.Q., Canada.

August 4
Division of Rubber Chemistry, Chemical Institute of Canada. Conference. Montreal, P.Q., Canada.

September 3-8
American Chemical Society. Chicago, Ill.

September 5-8
Division of Rubber Chemistry, ACS. Hotel Sherman, Chicago, Ill.

September 9
Connecticut Rubber Group. Outing.

October 3
The Los Angeles Rubber Group, Inc.

October 5
Detroit Rubber & Plastics Group, Inc.

October 10
Buffalo Rubber Group. Hotel Westbrook, Buffalo, N. Y.

October 13
Boston Rubber Group. Hotel Somerset, Boston, Mass.

October 17
Elastomer & Plastics Group, Northeastern Section, ACS.

October 20
New York Rubber Group, Henry Hudson Hotel, New York, N. Y.
Akron Rubber Group.

November 17
Connecticut Rubber Group.

December 8
Detroit Rubber & Plastics Group, Inc.

December 12
Buffalo Rubber Group. Christmas Party. Buffalo Trap & Field Club.

December 15
New York Rubber Group. Christmas Party. Henry Hudson Hotel, New York, N. Y.
Boston Rubber Group. Christmas Party. Hotel Somerset, Boston, Mass.

1962

January 26
Akron Rubber Group.

February 5-9
American Society for Testing Materials. Committee Week. Statler Hilton Hotel, Dallas, Tex.

February 6
The Los Angeles Rubber Group, Inc.

March 6
The Los Angeles Rubber Group, Inc.

March 23
New York Rubber Group. Henry Hudson Hotel, New York, N. Y.

April 3
The Los Angeles Rubber Group, Inc.

April 6
Akron Rubber Group.

April 24-27
Division of Rubber Chemistry, ACS. Statler Hotel, Boston, Mass.

June 7
New York Rubber Group. Outing.

June 22
Akron Rubber Group.

June 24-29
ASTM. Annual Meeting and Apparatus Exhibit. Statler Hotel, New York, N. Y.

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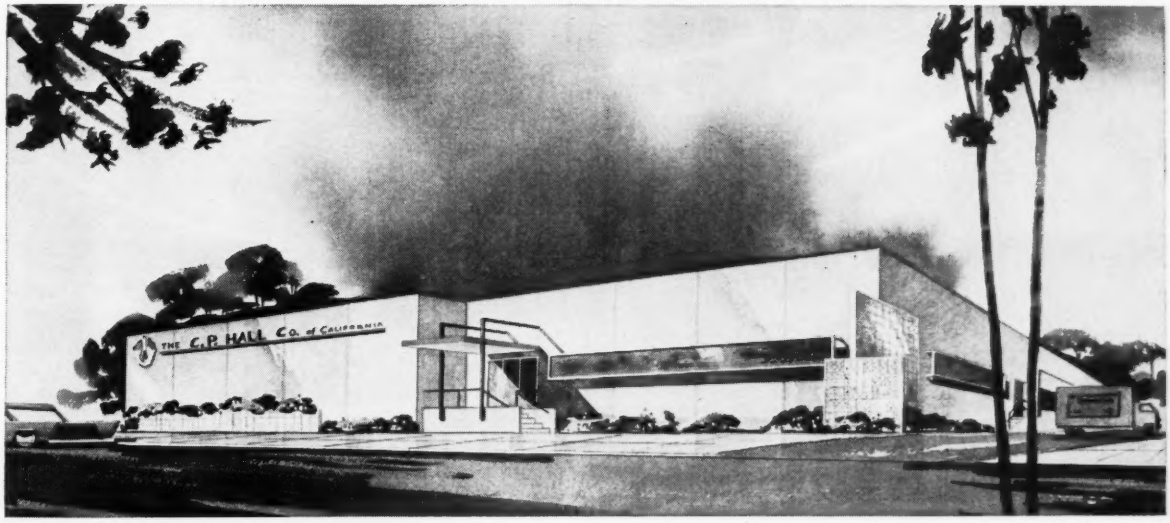

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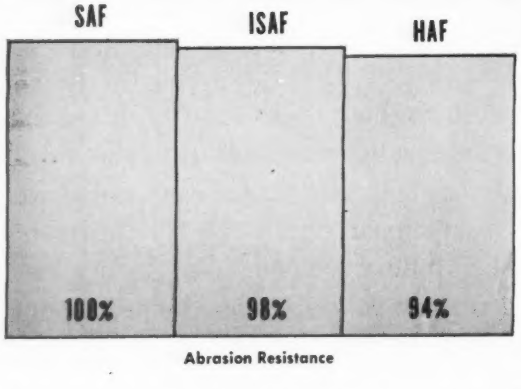
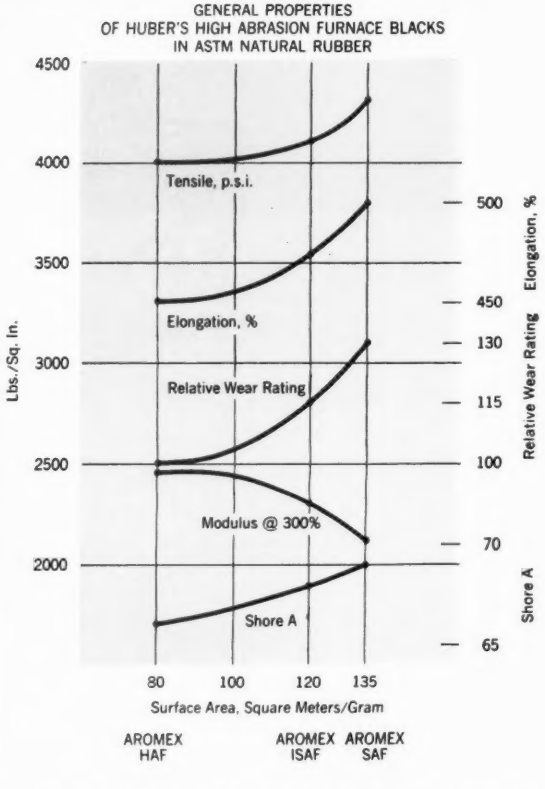


Abrasion Resistance



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Steps Needed to Meet Foreign Competition

It is becoming increasingly apparent that strong steps must be taken by industry, labor, and government in the United States if we are to be competitive with foreign products. The ever-increasing imports and the loss of export markets point out this fact quite plainly.

Booming business conditions in many parts of the world along with rapid technological development have created strong competitors. Common market areas, lower wages, and governments with favorable business outlooks have all helped create these competitive conditions.

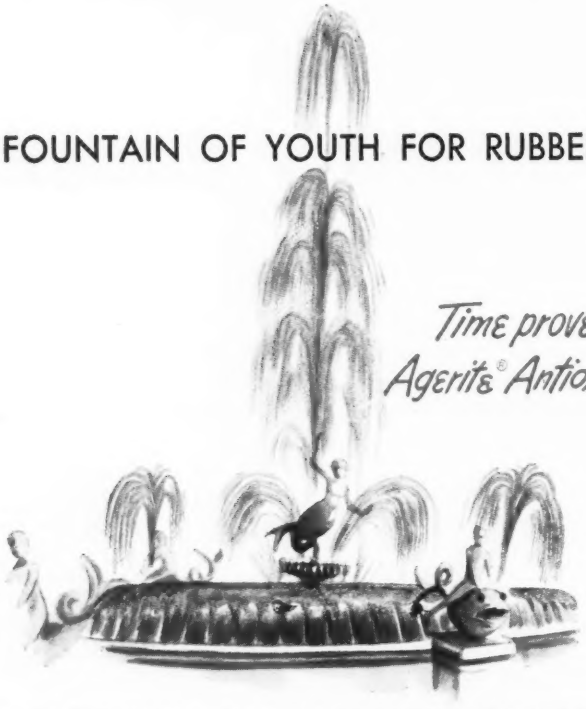
In a talk before the Ansonia (Conn.) Rotary Club, Farrel-Birmingham Co. President Franklin Farrel, 3rd, noted that such a situation exists and proposed some solutions to the problem. He makes the point, however, that we cannot depend upon technology alone to increase productivity and provide new products. We have no corner on brains in this country, and the many agreements for technological information exchanges between U. S. and foreign companies mean that most developments soon find their way overseas. Thus, it is wishful thinking to believe that the lower European wages can be offset by better methods.

Mr. Farrel's steps include allowing the gap between European and American labor rates to close and apply productivity increases to cost reduction; utmost cooperation between labor and management; government aid in the form of reduced corporate income taxes, overhaul and codify the antitrust laws to prevent unreasonable restraint of trade but be clear-cut and easily understood, leave foreign service personnel in their posts long enough to become expert rather than change posts frequently, and to match financial and insurance aid given by foreign governments; and finally, for industry to improve its competitive position by plant improvements, better products, better methods, research and development programs, or any other measures which will reduce costs.

R. S. Walker

EDITOR

FOUNTAIN OF YOUTH FOR RUBBER



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Contour Graph Analysis of Compounding Data[1]

New technique eliminates extensive calculations required by mathematical method and also provides means for quick analysis of interactions of properties as they are affected by same compounding variables

By P. F. BERTSCH

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

THE main occupation of the elastomer compounder is to define the quantitative effects of a series of controllable variables on a set of measurable properties. The variables may be curing agents, fillers, plasticizers, and other compounding ingredients, processing and curing temperatures, rates of extrusion, and, in fact, variables that he may control or measure. The properties may include tensile properties, tear strength, compression set, and other physical properties, processability, smoothness, appearance, color, and so on.

In recent years the field of statistics has provided a tool with which these quantitative relationships may be defined by a mathematical equation.[2] The equations may be used in turn to generate contour graphs similar to topographical and meteorological maps. With contour graphs, interaction of properties, as they are affected by the same variables, may be logically and systematically investigated. The compromises, which are possible among properties, are readily evident, and ability to meet specifications set by the manufacturer's customers in the industry can be quickly determined.[3]

[1] Developed from part of a paper presented before the Southern Rubber Group, Birmingham, Ala., June 10, 1960.

[2] P. F. Bertsch, "Proceedings of the International Rubber Conference, Washington, D. C., Nov., 1959, p. 255. Division of Rubber Chemistry, ACS, D. H. Behney, Treas., Harwick Standard Chemical Co., Akron, O.

[3] P. F. Bertsch, "Graphical Analysis of Compounding Data," BL Report No. 355, Du Pont elastomer chemicals department, June, 1959.

The Author

Paul F. Bertsch obtained his B.S. in chemistry from St. John's University in 1952 and his M.S. in industrial engineering from Stevens Institute of Technology in 1958.

He was employed by Raybestos-Manhattan, Inc., Passaic, N. J., from 1952 until 1955 when he joined E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department. In his present position with Du Pont he consults with chemists and engineers on problems requiring application of mathematics and statistics.

Mr. Bertsch is a member of the American Chemical Society and its Division of Rubber Chemistry and also of the Philadelphia Rubber Group.

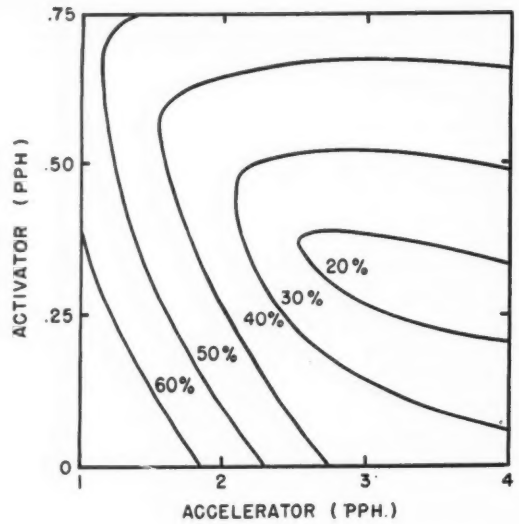


Fig. 1. Compression set contour graphs as they are affected by the activator and accelerator concentrations of an elastomer compound

bersome and tedious calculations the development of these contour graphs of properties.

It is our intent in this article to demonstrate this technique such that it will be usable to the reader immediately in his laboratory or factory.

An Illustration

An illustration of the usefulness of contour graphing should serve to motivate interest.

For this method of graphing, the variables (compounding or processing), such as the activator concentration and accelerator concentration as they affect the compression set of some elastomer as shown in Figure 1, appear on the contour graph similar to the way in which the latitude and longitude appear as the coordinates on the contour map. The property appears as a family of contour, each member of which is of constant value.

The major advantage of viewing data in contour form is clearly evident when a series of properties is to be studied. Since every property is analyzed over the same ranges for variables, i.e., over the same grid, they may be superimposed and studied simultaneously. For example, if in addition to compression set, the relationships of tensile strength and elongation to the activator and accelerator concentrations were identified also by

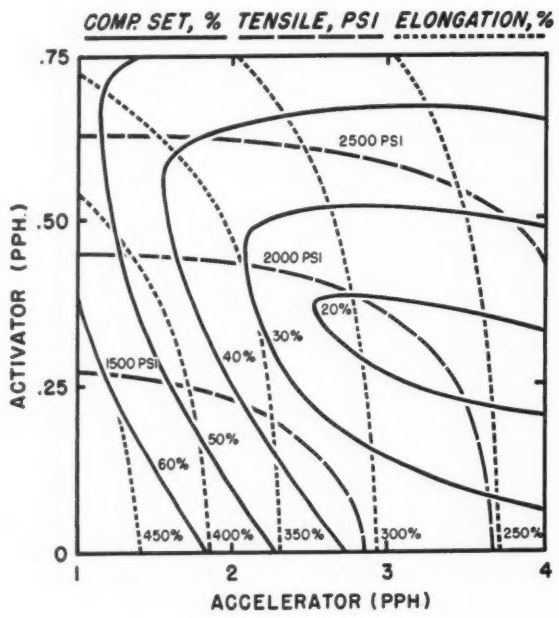


Fig. 2. Contour graphs for compression set, tensile strength, and elongation at break as they are affected by the activator and accelerator concentrations of an elastomer compound

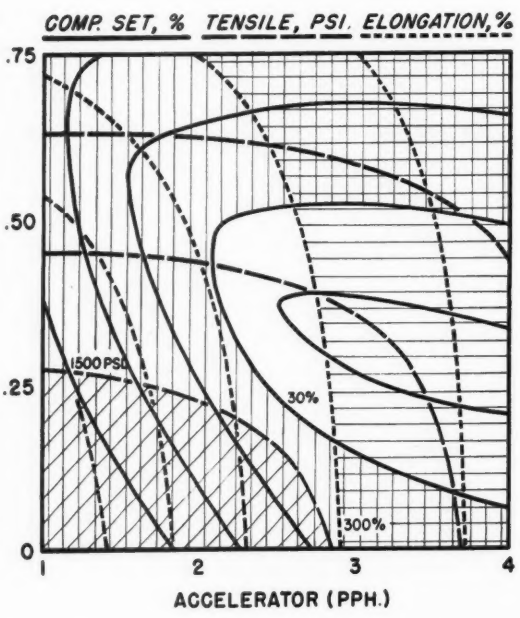
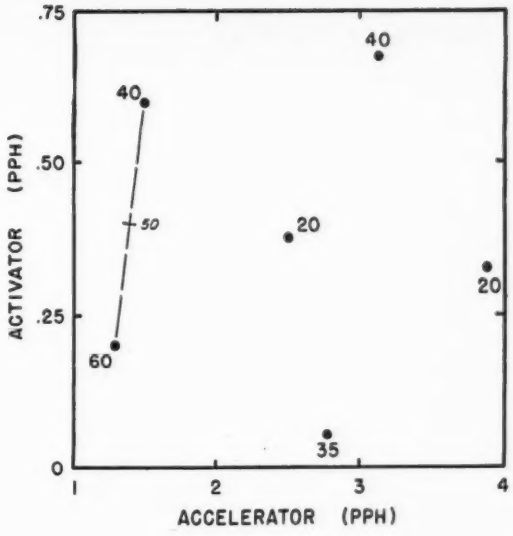


Fig. 3. The use of contour graphs to determine composition of compound with specific properties. Unshaded area provides many combinations of activator and accelerator in an elastomer compound that will give 1500 psi. minimum tensile, 300% minimum elongation, and 30% maximum compression set

To develop mathematical equations to represent the relationships which exist in reality is a technical activity and requires training and computing equipment.[4] The great value of viewing the relationships in the manner of contour graphs, however, need not be lost because trained statisticians and computers are not available to the rubber products manufacturer. For a limited, but often occurring class of problems, a graphical technique has been developed which approximates the mathematical approach and which allows without cum-

[4] P. F. Bertsch, "Compounding with Statistics," presented before the Southern Rubber Group, Birmingham, Ala., June 10, 1960. Du Pont elastomer chemicals department. Contribution No. 172.

Fig. 4. Plot of % compression set for six activator-accelerator combinations and linear interpolation between two of these compounds



contours, all three could be superimposed, as shown in Figure 2. With this device, questions such as the following are readily answered:

(1) Is it possible to obtain a compound (by varying the activator and accelerator concentrations) which has a 20% or less compression set value and a 400% or more elongation? (A study of Figure 2 will show that the maximum elongation attainable with 20% compression set is about 320% occurring at about 0.35-part of activator and 2.6 parts of accelerator.)

(2) Is it possible to obtain a compound with 1500 psi. minimum tensile strength, 300% minimum elongation, and 30% maximum compression set? (The unshaded area in Figure 3 provides many combinations of activator and accelerator to meet these requirements. If a family of compound cost contours were superimposed, the *lowest-cost* compound could be selected to meet the stated requirements.)

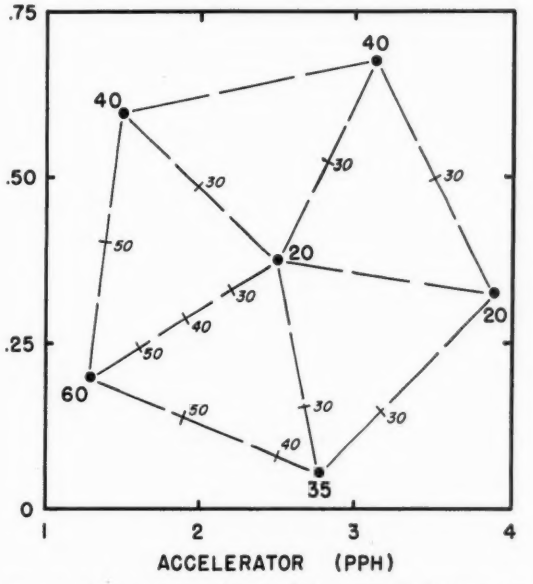


Fig. 5. Linear interpolation between all data pairs of six activator-accelerator combinations

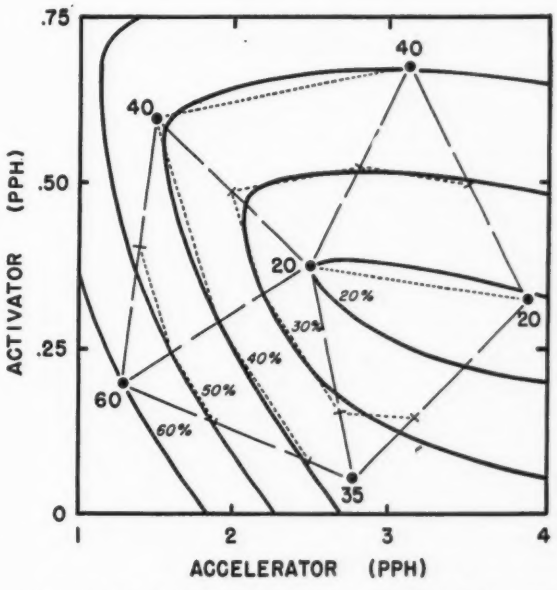


Fig. 6. Straight-line segments smoothed into continuous curved contours for the six combinations

The construction of contour graphs will be demonstrated for the compression set contours shown in Figure 1 and will then be extended by introducing a third variable, acid acceptor.

The Method

Figure 4 shows data for six activator-accelerator variations. Consider two of the data, i.e., 0.6-pph. activator-1.5 pph. accelerator and 0.2-pph. activator-1.3 pph. accelerator (40% and 60% compression set respectively). Given these data, can we make estimates where no property measurements exist? These two data points can be connected by a line; the line divided, and estimates obtained by linear interpolation as indicated in Figure 4. By applying this same simple technique, i.e., considering pairs of adjoining data points and dividing the differences between them, a pattern is developed, as shown in Figure 5. By joining those data and estimates which have equal value, families of straight-line contours are obtained as shown by the dotted lines in Figure 6. Since nature usually operates in a smooth, continuous manner, it is a reasonable refinement to smooth the straight-line segments into continuous curves as shown by the solid line in Figure 6.

Data collected for the same six compounds measuring the tensile strength could be fixed to their respective graphical locations. By following the rules outlined above, a family of contours peculiar to tensile strength could be developed and superimposed upon the com-

pression set. Similarly, contours for elongation, cost, and any other properties pertinent to the investigation could be constructed and likewise superimposed.

Three Variables

In extending the graphical method to three variables, let us consider two cases. First, assume that no interaction (synergism) is expected between the acid acceptor, which we will now vary, and either the activator or the accelerator. This assumption implies that the contours for compression set shown in Figure 1 (where acid acceptor is constant at 15 pph.) will remain intact except for a possible change in overall level. This assumption suggests also that we need to collect data at only one point each for the high and low levels, i.e., 20 and 10 pph. acid acceptor, respectively.

Figure 7 shows the data obtained at these points and the contours as they would develop from the data and our assumption. The technological conclusion from these contours is that the elastomer vulcanizate is at a maximum state of cure (i.e., minimum compression set) somewhere near the medium level (15 parts) of acid acceptor.

For the second illustrative case, let us assume that interaction is expected, i.e., a change in contour pattern or orientation is likely. We must collect enough data to measure such a change. Suppose several compounds are run at both the 10- and 20-part levels of acid acceptor, and the values obtained are shown in Figure 8. Four points each at the high and low levels of acid acceptor are not sufficient to generate contours measuring the accelerator-activator interrelationship as complex as those obtained at the 15-part level of acid acceptor using six compounds. In order to enjoy the economy of fewer points let us introduce a device which will put to use information obtained at the 15-part level, as well as the new data.

Replot the points from Figure 8 using differences between the values obtained at 10 and 20 parts with the corresponding values obtained at 15 parts. The difference values are plotted in Figure 9. Complete contours for these differences,[5] and estimate difference values for the two points not tested, as indicated by the X's in Figure 10. Apply these estimated differences to the corresponding values at 15 parts, and complete the contours at high and low acid acceptor values from the actual and estimated data, as shown in Figure 11. (Only the two points in each of the high and low acid acceptor valves indicated by the X's were estimated for this illustration. By overlaying the difference contours on the compression set contours previously obtained, and adding and subtracting as indicated, any number of compression set estimates can be made for the high and low acid acceptor levels.)

In review, to extend the graphical analysis method to three variables, we have:

(1) obtained data (under two different assumptions) at high and low levels of the third variable, acid acceptor;

(2) employed difference contours[6] which, because they are simpler, require less data; and

(3) constructed compression set contours from actual data and the estimates made from the difference contours.

Selecting Experiments

The complexity of the underlying system and the magnitude of error of the property measurement determine the ultimate data requirements for an accurate description of a relationship. Large error can produce spurious or distorted graphical representations of a system. Several approximate statistical tests can be made of the data to protect against error. They are touched upon in a following section on statistical considerations.

Usually the complexity of the system is unknown. The most efficient method of assessing the unknown, as far as economy of experiments is concerned, is to run a moderate number of experiments which will be sufficient if the system is not too complex and which will clearly point to the next area of experimentation if the system is complex.

The following are guides to experimental planning for the graphical analysis.

(1) Carefully evaluate the experimental situation in light of intuition and experience. Figure 12 shows an example of how such a background might establish the practical experimental area.

(2) Use intuition and experience to hypothesize concerning the degree of complexity expected. Choose some number of experiments which balances hypothesis with time requirements and with economy of experiments. For two variables, the maximum number of experiments which would normally be run at one time would be about nine, for three variables, about 15. If time is not of the essence and a sequential attack is planned, six experiments for two variables and from seven to 11 for three (depending upon interaction hypotheses) should be sufficient. If experimentation is extremely expensive, or if the investigation is of a screening nature, three or four experiments for two variables and six for three should be sufficient.

(3) After establishing the practical experimental area and the number of experiments, the selection of the experiments from the space must be made. In the absence of evidence for the contrary, a symmetrical design is suggested for the first sequence, that is, for two variables four points might be arranged in a square or an equilateral triangle with a center point. Six points could be arranged as a regular pentagon with a center point if the experimental area is symmetrical.

If the area is established as in Figure 12, an array such as shown in Figure 13 could be used. In this case a "central" point was first chosen. Then the point designated as "2" was picked because of a promise of interesting property values. The remaining four points were placed on the periphery of the area by dividing the 360 degrees about the center point into five equal angular distances (72 degrees) and noting where rays emanating from the center at these equiangular distances intersect the periphery. If seven points were used in this area, the

[5] The section of this paper on "Statistical Considerations" discusses the justification of difference contours.

[6] The "difference contour" for the no-interaction case is a constant, i.e., the single difference measurement.

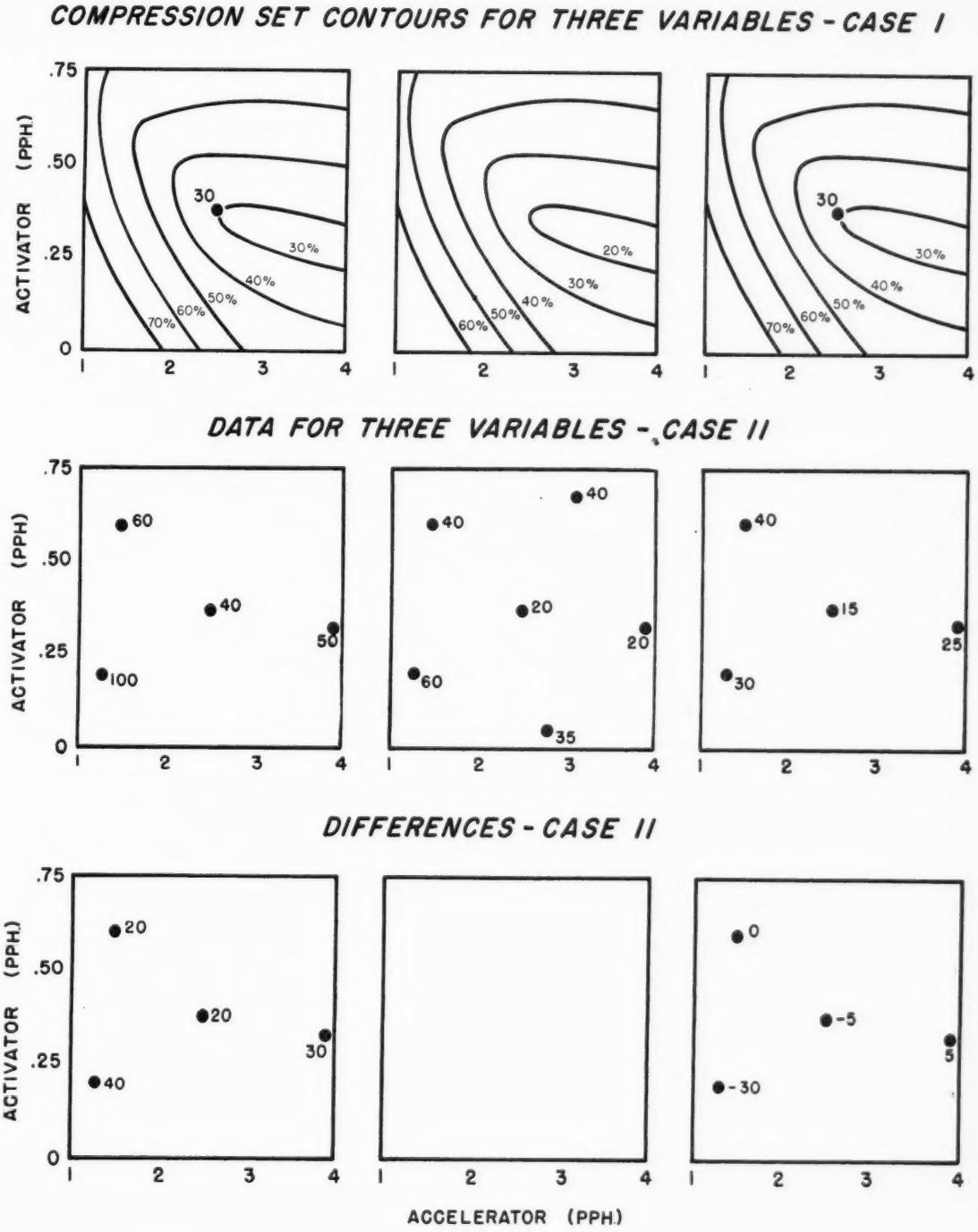
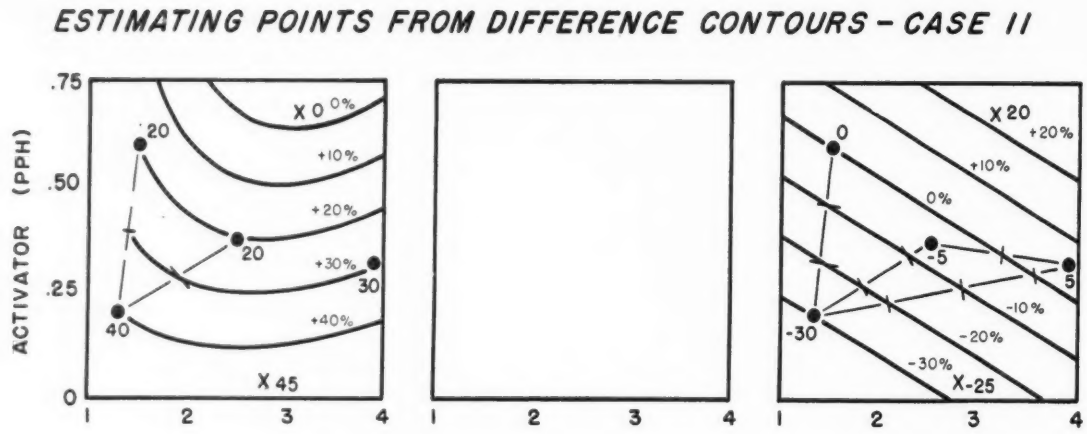
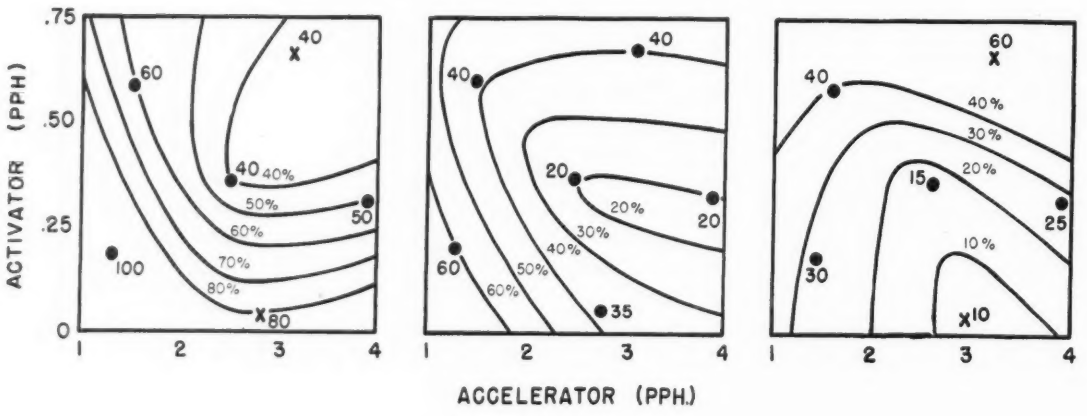


Fig. 7 *(top row)*. Compression set contours for three variables—Case 1 (no interaction)

Fig. 8 *(center row)*. Plot of % compression set for three variables—Case 2 (interaction expected)

Fig. 9 *(bottom row)*. Plot of differences in % compression set values between 10 and 15 pph. of acid acceptor and 20 and 15 pph. of acid acceptor—Case 2





ACID ACCEPTOR:

10 PPH. 15 PPH. 20 PPH.

Fig. 10 *(top)*. Contours for differences and estimates of difference values for two points not tested on both 10 and 20 pph. of acid acceptor—Case 2

Fig. 11 *(bottom)*. Compression set contours—Case 2. Estimated differences from Figure 10 applied to 15 pph. acid acceptor values and contours completed for high and low acid acceptor values

angular distances between rays would have been

$$\frac{360^\circ}{6} = 60^\circ.$$

For three variables, the effect on selecting data of hypotheses concerning interactions has been illustrated in the example in connection with compression set under the heading "Three Variables" above.

Statistical Considerations

The following remarks are directed to those who are engaged in or interested in applications of statistics to elastomer problems.

(1) The graphical method described above is an approximation of the descriptions obtained with regression analysis.[2] Analyses that have been executed by both graphical and statistical regression techniques are comparable.[3] It is assumed, therefore, that the error introduced by obtaining contours by smoothing straight line segments (see Figure 7) is not substantial. By contrast, the computational effort saved by using the graphical technique is considerable.[7]

(An added advantage of the graphical method over the mathematical is that the analyst is not required to make a prior choice of a mathematical model to describe the relationship. It often happens that the first choice of the mathematical model is inadequate, and considerable computational effort is expended on refitting coefficients for the new model.)

(2) If it is suspected that the graphical contours are too complex for the number of data used, a sum of squares can be calculated from the graphical differences between data points and contour estimates. The variance can be obtained by dividing the sum of squares by an estimate of degrees of freedom. The latter would be the number of data points minus the number of

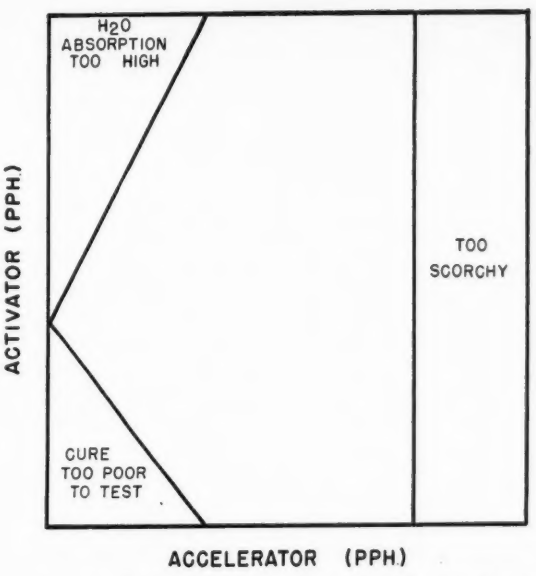


Fig. 12. Restriction of an experimental area based on previous knowledge and experience

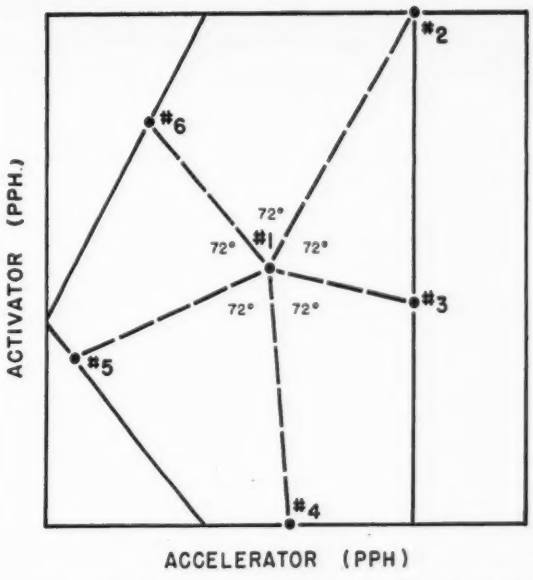


Fig. 13. Selection of six points for obtaining data within the area decided upon in Figure 12

terms which would be necessary to describe the contours with a polynomial.

For example, the three-variable compression set illustration shown in Figure 11 appears to be almost quadratic in x_1 and x_2, but with quite radical changes and interaction in x_3. A polynomial to describe this system would use at least the limit of 11 available from the 12 data. This would leave one degree of freedom to estimate a variance. If the variance so measured is smaller than an independent measure of error, it indicates that the system is too complex to be described with the data on hand, and more data are necessary to assure accuracy of description.

(3) Intervals for contour values should certainly be greater than experimental error. For example, if tensile strength has two sigma limits of ± 200 psi., the contour interval should be at least every 400 psi. Furthermore, if two data values are close enough that a real difference is questionable, test that difference by the t test.[7]

(4) If several data points are rather close in value, their variance may be tested by the F ratio test[7] if an independent measure of error is available. (If the differences in either the t test or F test case are not significant, the average value may be used for those points in question.)

(5) Note in the graphical method that the center point is part of every triangle used to construct the contours. Since this point has such an influence on the total analysis, it is wise to run the point two or more times and use the average. This problem of the center point seems to be analogous to that for designs in regression analysis.[8, 9, 10]

(6) The difference contours used in the steps described in Figures 10 and 11 are justified as follows. If a polynomial was used to describe the relationship and an assumption made that a linear relationship is sufficient to describe the effect of x_3 between the medium and high levels, (likewise between the medium and the low), then the polynomial model for a difference would be $y = b_3 z + b_{13} z x_1 + b_{23} z x_2 + b_{12} z (H_i)$, where $z = (x_3 \text{ high} - x_3 \text{ medium})$, and H_i = higher-order cross-products.

Since z above is a constant, and usually higher- order cross-product terms are unnecessary, three difference points and the linear difference contours obtained from them would normally be enough. In case of doubt about the existence of higher order interactions, more than three values should be obtained. For the compression set case illustrated in Figures 8, 9, 10, and 11, four different values were used. Note (in Figure 10) that between the medium and high levels three points would have been enough, but that four were necessary between medium and low x_3 since the difference contours are curved. This does indicate the existence of higher-order cross-products at least between medium and low x_3.

Summary and Conclusions

We have seen that simple linear interpolation coupled with a graphical representation of an experimental area and the data collected therein provide an information picture of the effects of compounding variations. The accuracy of the contour graphs can be tested by intuition (concerning feasible effects and the magnitude of error), by independent data checks, or by approximate statistical tests.

The technique is not restricted to compounding studies, but may be applied to any experimental situation where the variables are accurately controlled or measured and where the properties are measured with known or measurable variability.

[7] O. L. Davies, "Design and Analysis of Industrial Experiments," Hafner Publishing Co., Inc., New York (1956).
[8] G. E. P. Box and K. B. Wilson, "On Experimental Attainment of Optimum Conditions," *J. Royal Statistical Soc.*, 13, 1 (1951).
[9] G. E. P. Box, "Multifactor Designs of First Order," *Biometrika*, 39, 49-57 (1952).
[10] G. E. P. Box and J. S. Hunter, "Multifactor Experimental Designs," *Ann. of Math. Statistics*, 28, 195-241 (1957).

Tomarkin Tire To Hit Market in Fall

New type of all-weather tire uses elastomeric additive to improve traction on snow and ice

THE Tomarkin tire, a new type of all-weather tire that uses an elastomeric additive to obtain traction on ice or snow, will go on the market this fall.

At present the tire is scheduled only for the Canadian market. There is a very good chance, however, that it will be introduced in the United States before the snow flies this coming winter.

Leandro Tomarkin, developer of the tire, has signed an agreement with Atlas Supply Co., Newark, N. J., a tire, battery, and automotive accessory engineering organization, for manufacture of the Tomarkin tire in the United States, and a similar agreement for Canada with Imperial Oil Co. of Canada, Ltd. Imperial will distribute the tire this fall and has arranged for Dominion Rubber Co., Ltd., to manufacture the tires.

In addition, under the agreement with Dr. Tomarkin, Atlas has to date signed license agreements with United States Rubber Co., New York, N. Y., Mansfield Tire & Rubber Co., Mansfield, O., and Imperial Tire & Rubber Co., Hackettstown, N. J., the last a manufacturer of retread materials. According to Atlas, other tire companies have also expressed interest in use of the process, and other sublicensing agreements may be forthcoming soon.

Although no price schedule has been set for the tires, indications are that Atlas and Imperial Oil Co. will sell them as a premium price tire, at least to start.

Not a Snow Tire

The Tomarkin tire, on which U. S. patents are pending, is not a snow tire as such. It is a standard tread tire with a dispersion of tiny elastomeric particles in the tread. The particles, which are cubes about $\frac{3}{32}$-inch in each dimension, are harder than the tread stock. They wear slightly faster than the tread stock, giving the tread an irregular surface.

Just what the composition of the particles is has not been revealed either by Dr. Tomarkin or by Atlas. Dr. Tomarkin, however, says that these particles are compatible with butyl rubber as well as with natural rubber and SBR. The particles are partly cured before they are incorporated with other ingredients of the tread stock in the last phase of milling. Cure of the tread stock is not affected by the particles, Dr. Tomarkin declares.

Under specifications set up by Atlas in the licensing agreement, B. D. Caulkins, vice president of Atlas, explained, manufacturers must disperse the Tomarkin particles in the tread to a depth of at least two-thirds of the tread in order to retain skid resistance for most of the life of the tire.

The added skid resistance claimed for the Tomarkin tire is said by Dr. Tomarkin to be due mainly to three causes:

1. The irregular surface obtained when the particles wear away faster than the surrounding tread stock increases the frictional resistance between the tire tread and the road.

2. The tiny cavities created by wear of the particles develop a "squeegee" action on a wet surface such as snow, ice, or rain-drenched road, reducing the lubricating film of water at the interface between tread and road surface.

3. Because of the composition of the particles, the particle-tread system has high hysteresis, a property which current tire research indicates has the effect of increasing a tire's coefficient of friction.

Anti-Skid Additives

The method of incorporating foreign particles in a tire to increase skid resistance is not new. Corn cobs, walnut shells, grit, sand, and salt have all been used for that purpose, and one of the major tire companies tried sawdust as an anti-skid additive some time ago. The foreign body wears away faster than the tread compound and is dislodged, creating cavities which make the tread surface irregular and thus increase the coefficient of friction. Such additives did increase skid resistance moderately, but only at the cost of a sharp decrease in tread life. The added tread wear was as high as 50% in some cases.

Because the Tomarkin compound is vulcanized to the surrounding tread rubber, the particles are not dislodged. Therefore, according to Tomarkin and Caulkins, there is only a slight increase in tread wear, so slight as to be insignificant.

Although Atlas is not recommending the Tomarkin tire in direct competition with conventional snow tires, Caulkins feels that it has several advantages over a snow tire.

First, the snow tire obtains additional traction in soft, deep snow when snow is trapped between the lugs in the tread pattern and must be sheared away. A snow tire, however, is not particularly efficient on ice or packed snow partly because no snow is trapped between the lugs, and partly because less tread rubber is actually in contact with the surface of the ice or snow than is the case with a standard tread tire.

Most of the time, however, Caulkins points out, the winter driver is traveling on packed snow or a thin film of ice rather than deep snow. This is because when the plows clear the roads after a deep snow, they leave a coating of snow on the surface of the road. This remainder becomes packed hard and freezes, becoming extremely slippery.

According to both Caulkins and Dr. Tomarkin, the Tomarkin tire has shown excellent skid resistance on packed snow, ice, and rain-soaked roads. This is be-

Leandro Tomarkin—Inventor, Doctor, Chemist, Biologist

Leandro W. Tomarkin, developer of the Tomarkin all-weather tire, has had a highly varied career as chemist, physician, medical researcher, and biologist, but the tire field is a new one for him.

He began his career as an industrial chemist, serving as aide to the chief chemist, industrial department of the Municipality of Berne, Switzerland, from 1918 to 1920, developing a process to recover ammonia from by-products of the distillation of lignite, a low grade of coal, and a continuous process for manufacture of calcium oxide from calcium carbonate and calcium sulfate.

In 1920 he left his post to take up the study of medicine and after receiving his medical degree engaged in original research. In 1922 he developed a technique for using an anti-microbe in treatment of lobar and bronchial pneumonia, a type of therapy used widely in Europe for the next five years, and in 1924 he began investigating the formation of the diphtheria toxoid for active immunization against diphtheria. Then in 1926, Tomarkin developed a treatment of tuberculosis with an active therapeutic constituent isolated by him from the Koch tuberculin. The treatment was used in tuberculosis sanitoria in the United States and Europe for a number of years.

In addition he did work in chemical therapy for subtropical diseases, surgical infections, and septicemia, or blood poisoning.

In later years, from 1943 to 1946, he was director of clinical research for the Canadian Radium Uranium Corp., working on use of radiation in treatment of disease. After World War II he worked with the United States Department of Agriculture in testing the effects of radiation on plant growth.

Dr. Tomarkin has been quite active in international scientific communication, serving as secretary-general of 11 international congresses, including the First and Second International Congresses of Physics, Chemistry and Biology, in Paris in 1937 and New York City in 1940. In 1930 he organized the first celebration of International Cancer Week, and in 1938 the international celebration of the discovery of radium, X-rays, electrons, and Hertzian waves. Both were held in 40 countries.

cause its skid resistance is based on the properties of the tread rather than on the amount of snow trapped between the treads.

Second, because of the way the snow tire obtains its traction, the efficiency of the tire is decreased as the tread is worn down. According to Caulkins, the Tomarkin tire shows no loss in skid resistance as the tread wears. In addition, because it has greater tread surface in contact with the road than the snow tire, the Tomarkin tire has an initial advantage in traction.

Third, the snow tires are useful only when used on rear wheels. The Tomarkin tire, on the other hand, is recommended for use on all four wheels and therefore gives good traction in braking and steering.

Tests Began in 1957

Dr. Tomarkin first began testing his compound in road tests in 1957 after considerable research with the American Hard Rubber Co., Butler, N. J., on the particles themselves. American Hard Rubber is now the manufacturer for the particles. The road tests were made with experimental recaps made by Daleley Tire Service, Monsey, N. Y., from tread rubber made for Dr. Tomarkin by Imperial Rubber Co.

During February and March of 1957, and again from December, 1957, through February, 1958, he conducted tests on Cohasset Road in the Bear Mountain region of New York State. The road was chosen because of hills ranging in grade from six to 18 degrees, sharp turns, and sharp banking at turns. While being driven on icy or snow-covered roads, the car maintained traction and stability at speeds of 30 to 40 miles an hour, both in steering and in stopping and starting on icy grades, Tomarkin reported.

He also reported that his car negotiated hills with grades from six to 18 degrees, driving at six to 8 miles an hour in order to minimize the effect of momentum. Another car equipped with snow tires was unable to make the hill after stopping, but the car with the Tomarkin tread was stopped and restarted without spinning or skidding, he said.

In tests in the same area, Tomarkin tires were compared against standard-tread tires. Tomarkin tires making downhill stops over five- to 28-degree grades skidded only five to six feet at 10-12 miles an hour, compared with 50 to 60 feet for the standard tires, and skidded only three to five feet in crash stops on the level at 20 miles an hour, compared with 28-32 feet for the standard tires, Dr. Tomarkin reported.

Dr. Tomarkin continued his tests, and in the Winter of 1958-59, Atlas began road testing the tires. In January, 1960, Atlas placed 100 sets of four tires each on cars in the northern United States snow belt, from Maine to Washington. In addition, a number of tires recapped with the Tomarkin compound were placed on selected cars. In all cases the persons who tried out the tires were those whose jobs required them to drive a great deal under a variety of conditions. At the time of reporting, this spring, they had driven

Drivers' Reactions after Testing Tires

The following are some of the comments volunteered by some of the 100 persons who tested Tomarkin tires in the Atlas 1958-59 program:

"I hesitate in being too enthusiastic on these tires. However, during the worst of our snow and blizzards I subjected them to the most severe test and yet moved about with comparative ease. The only exception was unusually deep banks or drifts which would have stopped any tire."

"I have experienced in the past two weeks on both snow and ice the following: A definite superior traction on both snow and ice. While other cars fishtail, these tires will not do this unless you gun the car excessively. On hill grades I have passed cars that are spinning in one spot. This is a definite safety factor."

"Experience in light or heavy snow very good, but on packed snow such as parking lots and on ice, braking quality is poor."

"I must mention again the excellent results in ice and snow. I cover rural area known as snow belt of western N. Y. with much rough driving weather. Can't praise this value of tires enough."

"Tires give good braking and stopping traction, something I've never found with any other tires on ice before, also can drive reasonable speed without swaying."

"Had some difficulty on bad ice."

"No trouble either stopping or going. Have gone up hills where other cars could only go up part way that I have witnessed."

"It is my personal opinion that these tires tractionize in snow in a manner far superior to any tire I have previously had experience with . . . My only complaint in this test was the braking qualities both in snow and on ice. These tires also have excellent qualities on wet pavement."

an average of more than 2,500 miles on the Tomarkin tires.

Comments varied, depending on the experience of the driver with other tires. They ranged from the comment, "These tires are the best winter tires for all-around use that I have ever used," to "not very good," or "poor traction."

On the whole, however, reactions were extremely favorable. Of the 51 persons who replied, only one person rated the tires poor in light snow, and one rated them fair. A total of 44, or 88%, rated the tires good or excellent, and three persons said they were better than mud or snow tires. (Since no specific choice of ratings was given, many of the persons who rated the tires good or excellent may have meant that they were as good as or better than mud or snow tires.)

In heavier snow, four persons said the tires were poor, and four rated them inferior to mud or snow tires. Five said they were about the same as mud or snow tires. Some 28 persons, or 53.3% of the total, rated the tires good to excellent, and nine said they were superior to mud and snow tires.

On ice only two persons rated the tire poor, and one rated it inferior to mud and snow tires. Three persons said the tire was the same as mud or snow tires. Three persons rated the tire fair, 35 called it good to excellent, and 10 said the tires were better than mud or snow tires.

(Because of the variety of ratings, it is difficult to say under which conditions the tires were rated best. However, the fewest poor ratings were given for light snow or ice conditions.)

Caulkins felt that the reactions of experienced drivers on an extended service test were as good as could possibly be expected, and that the few unfavorable reactions might be expected, and that the few unfavorable reactions might be due to the drivers expecting better results than could be realized in winter.

He also noted that it is necessary to drive the tires on dry pavement for a short time to expose the particles before maximum traction can be obtained, and that the first experience may not be entirely satisfactory if the motorist has the tires placed on his car when the roads are already snow covered.

Further tests were made during the past winter on airport limousines, police cars, telephone repair trucks, and other types of vehicles which must operate under all conditions. The New York Telephone Co. put Tomarkin tires on 61 half-ton trucks and compared results with those on 95 half-ton trucks with standard tires. The drivers were not told which type of tires they were using.

The trucks were all driven 9,500 miles, and drivers rated the tires on uphill and downhill driving, braking and parking in both light and heavy snow. A point system was used to tabulate results. Of the total points on Tomarkin tires, the ratings were 59% good, 35% fair, and 6% poor. For the standard tires the figures were 33.3% good, 41.7% fair, and 25% poor. On ice Tomarkin tires rated 29% good, 57% fair, 14% poor; standard tires, 9.2% good, 26.5% fair, 64.3% poor.

Although the tests were responsible for the Atlas interest in the Tomarkin tire, an experience by Caulkins may have given personal confirmation for the decision. During one of the most severe snowstorms of the 1959-60 winter, the Atlas executive drove home from his office in a car equipped with Tomarkin tires. Then he and his wife drove back through streets crowded with abandoned cars to the Pennsylvania Railroad station in Newark, where they took a train for New York City and a dinner and theater date. By this time all tunnels into New York were closed. After the theater they took the train back to Newark and drove home, arriving not much later than they would have in good weather.

The Cure of Chlorobutyl Blends With Other Rubbers[1]

Cure systems described for blends with NR, SBR, CR or NBR to obtain best balance of properties

By G. J. ZIARNIK, F. P. FORD, and J. T. KEHN

Esso Research & Engineering Co., Linden, N. J.

SINCE the introduction of butyl rubber in 1943, technologists have sought to blend butyl with other rubbers. The potential advantages of combining the stability and impermeability of butyl with the reactivity of highly unsaturated elastomers are well known. The problem of compatibility, which was uncovered in the early days of butyl's commercial development, however, has prevented the use of such blends in practical applications.

The incompatibility of butyl with other rubbers has been attributed to rapid utilization of curatives by highly unsaturated rubbers at the expense of the slower curing butyl.[2] That other important factors are involved was indicated in the work by Ford and Zapp.[3] Quite apart from the "curative starvation" theory, it was suggested that incompatibility of blends may also be related to physical immiscibility[4] of butyl resulting from lack of sufficient polarity or functionality. These authors found, however, that vulcanizate compatibility could be markedly improved by specific curative systems. For example, the addition of lead compounds to conventional thiuram and carbamate compositions or the use of certain mild accelerators yielded vulcanizates with improved properties and appearance. More exacting criteria, however, revealed serious weaknesses in tensile and dynamic properties of blends vulcanized under such conditions.

The halogenation of butyl rubber contributed to the solution of the problem of compatibility. Morrissey[5] has published information on brominating butyl. Baldwin and Kuntz[6] have reported that under certain conditions halogen is introduced into an allylic position in the butyl molecule, and that the dual functionality of unsaturation and chlorine results in a faster curing polymer that is receptive to a wide range of curing agents. This versatility permits the designing of vulcanization systems to achieve optimum performance in blend vulcanizates. Thus, the commercial production of chlorinated butyl rubber (MD-551 or Enjay Butyl HT 10-66)[7] now makes possible and practical the blending of a butyl-type polymer with other rubbers to improve product quality, and compound processing and to effect cost savings.

In discussion of effects of vulcanization systems, major emphasis is given to blends of chlorobutyl with natural rubber, SBR, and neoprene. The following formulation with minor variations was mixed in a "00" Banbury and used in this evaluation:

	PHR
Polymer	100
Antioxidant	1
HAF black	50
Stearic acid	1

Criteria for acceptable vulcanizate performance include good stress-strain properties, stability during severe flexing tests, and other quality improvements.

Chlorobutyl-NR Blends

Blend properties are influenced by the cure system employed. In blends of chlorobutyl and NR, sulfur cures are less scorchy and more extensible when combined with slow or delayed-action accelerators. TPG,[8] DOTG, 2-MT, and Santocure with zinc oxide will cure chlorobutyl with or without sulfur. Any "robbing" of sulfur by NR, therefore, does not prevent chlorobutyl from curing.

Table 1 compares the effect of cure system on the stress-strain properties, both original and aged, of blends. The first compound employs conventional curatives consisting of primary and secondary accelerators with sulfur. Such a system tends to overcure the rubber phase, resulting in low extensibility and high hardness. The remaining compounds in the table illustrate how

[1]Presented before the Division of Rubber Chemistry, ACS, New York, N. Y., Sept. 15, 1960.

[2]Robert M. Thomas and William J. Sparks, Chap. 24, p. 854, "Synthetic Rubber," edited by G. S. Whitby, C. C. Davis, R. F. Dunbrook, John Wiley & Sons, Inc., New York (1954).

[3]F. P. Ford and R. L. Zapp, "Vulcanization of Butyl with Other Rubber," presented before the Division of Rubber Chemistry, ACS, Philadelphia, Pa., Nov. 3, 1955.

[4]G. L. Slonimskii and N. F. Komskaya, *Rubber Chem. & Tech.*, 31, 224 (1958), found also that even highly unsaturated elastomers such as SBR and NR possess only limited mutual solubility.

[5]*Ind & Eng. Chem.*, 47, 1562 (1955).

[6]"Encyclopedia of Chemical Technology," Second Supplement, pp. 716-34, The Interscience Encyclopedia, Inc., New York (1960).

[7]Enjay Chemical Co., Division of Humble Oil & Refining Co., New York 19, N. Y.

[8]Composition and sources of supply (when available) of this and other compounding ingredients used in this work will be found in the Appendix at the end of this paper.

TABLE 1. EFFECT OF CURE SYSTEM ON VULCANIZATE PROPERTIES OF CHLOROBUTYL-NR BLENDS*

Compound No.	1	2	3	4	5	6	7	8	9	10	11	12
Chlorobutyl	50.0	50.0	50.0	50.0	50.0	50.0	50.0	75.0	75.0	75.0	100.0	—
NR (No. 1 RSS)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	25.0	25.0	25.0	—	100.0
TMTDS	0.4	—	—	—	—	1.5	1.5	0.15	1.5	1.5	1.5	1.5
MBTS	1.0	—	—	—	—	—	—	1.5	—	—	—	—
TPG	—	2.0	—	—	—	—	—	—	—	—	—	—
DOTG	—	—	1.5	—	—	—	—	—	—	—	—	—
2-MT	—	—	—	2.0	—	—	—	—	—	—	—	—
Santocure	—	—	—	—	1.5	—	—	—	—	—	—	—
MBT	—	—	—	—	—	—	1.0	—	—	1.0	—	—
Sulfur	2.0	1.0	1.2	1.0	1.0	—	—	1.0	—	—	—	—
ZnO	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Original Properties Cure: 30 min./307° F.												
Tensile, psi.	1900	2320	2450	2010	1940	2530	2150	2260	2630	2540	2560	2320
Elongation, %	160	480	450	430	310	470	490	260	350	410	410	480
300% Modulus, psi.	—	1370	1700	1380	1850	1450	1200	—	2200	1660	1820	1220
Hardness, Shore A	75	60	65	65	70	60	58	70	65	62	62	53
Mooney scorch, MS 260° F., T_5	5	16	8	10	11	6	13	8	5	—	6	10
Aged Properties, 72 Hrs. at 250° F.†												
Tensile, psi.	—	—	—	1180	—	880	1340	1850	1570	2170	2090	400
Elongation, %	—	—	—	150	—	200	340	180	220	330	320	290
Hardness, Shore A	—	—	—	78	—	73	70	80	73	70	67	45
Ozone Resistance‡												
Min. to crack	—	4.5	—	—	—	5.0	—	—	8.0	—	14.5	1
Break	—	12.0	—	—	—	10.5	—	—	19.5	—	88.5	3.5

*Masterbatch of 100 polymer or polymer blends, one of Antioxidant 2246, 50 of HAF black, and one of stearic acid used.
†Tensile dumbbells were aged in circulating air oven (ASTM D 573-51).
‡Test carried out at room temperature in 0.2% ozone at 50% extension. Tensile dumbbells stretched 50% and allowed to rest 30 min. before testing. Ozonator (Welbach Corp., Ozone Processes Division, Philadelphia 29, Pa.) was source of ozone. Cracks were observed with 2X hand-glass.

TABLE 2. VULCANIZATE PROPERTIES OF 50 CHLOROBUTYL/50 NR BLENDS

Cure: 280° F./30 Min.

Cure System	1.5 DOTG 1.2 Sulfur 5.0 ZnO	1.5 TMTDS 2.0 MBTS 5.0 ZnO
Tensile strength, psi.	2000	2000
Elongation, %	550	470
300% Modulus, psi.	1050	1300
Hardness, Shore A	60	64

cure systems can be adjusted to give greater tensile strength, improved elongation, and reduced hardness. In general, process safety increases, yet sufficient reactivity remains for vulcanization as low as 280° F., as shown in Table 2.

That more homogeneous vulcanizates are realized with adjusted cure systems is illustrated by scorch curves in Figure 1. Slow accelerators (TPG) produce a smooth rise in Mooney viscosity reading with time. With primary and secondary accelerators (TMTDS-MBTS), sulfur cures yield scorch curves characterized by peaks, indicating that the two polymers are curing at significantly different rates.

Sulfur donors (TMTDS) alone, i.e., without elemental sulfur (Compound Nos. 6 and 9 in Table 1), will effectively cure chlorobutyl/NR blends. Such compounds are scorchy, but can be slowed down with secondary accelerators (Nos. 7 and 10) to yield a smooth scorch curve as shown in Figure 1. MBT is preferred to MBTS in such blends since the latter has a tendency to bloom. This type of vulcanization system imparts best heat resistance to blends, and aged vulcanizates retain greater tensile strength and elongation than sulfur

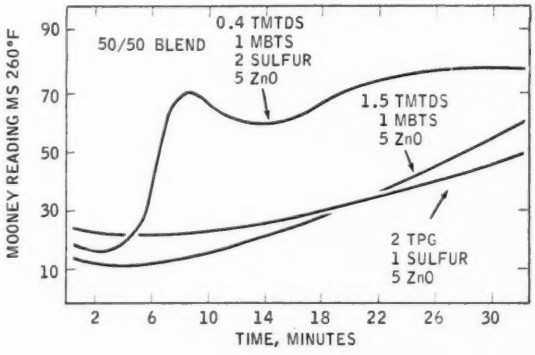


Fig. 1. Effect of cure system on Mooney scorch of chlorobutyl-natural rubber blends

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cures. The superiority of sulfur donors over free-sulfur in heat aging tests is illustrated by the data in Table 1. Hardness increase on heat aging appears to be independent of vulcanization system and is higher in blends than in either polymer alone.

Chlorobutyl possesses the same good low-temperature properties of regular butyl rubber. Blending with natural rubber improves low-temperature performance of chlorobutyl rubber still further. Well-adjusted cure systems, however, yield the best properties; tight cures with low elongation do not perform so well. The TMTDS cure appears best in low-temperature tests. An 80 chlorobutyl/20 NR blend with 10 phr. of process oil has a brittleness temperature of —69° F. in an HAF stock. A 50/50 blend with no process oil possesses a brittleness temperature of —73° F. The TPG-sulfur cure is almost as good and offers better scorch safety. Figure 2 compares the results of a Clash-Berg torsional modulus test (ASTM[9] D 1043-51) with these two cure systems.

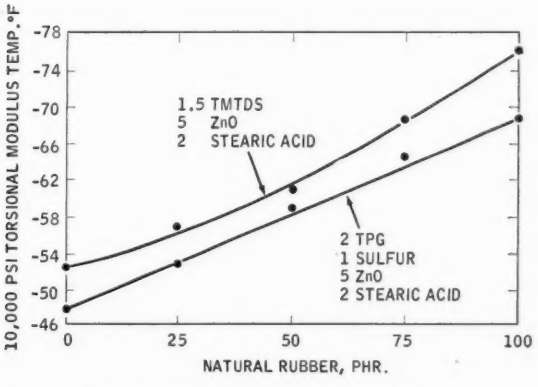

Fig. 2. Blending with natural rubber improves the low-temperature properties of chlorobutyl rubber

The compatibility of chlorobutyl and natural rubber is demonstrated in severe flexing tests (Goodrich flexometer). Using an 89-psi. load and 0.25-inch stroke, 75 chlorobutyl/25 NR blends were tested for 30 minutes at 212° F. All three types of cure systems survived the test—sulfur with primary and secondary accelerators, sulfur with slow accelerators, and sulfur donor. Best results were realized with the TMTDS cured compound which exhibited no porosity and had only 3.6% permanent set.

Ozone resistance is at a respectable level even in 50/50 blends. Crack times of more than four minutes are obtained in greatly accelerated ozone tests (0.2% ozone); whereas under the same conditions natural

[9]American Society for Testing Materials, Philadelphia 3, Pa.

TABLE 3. EFFECT OF CURE SYSTEM ON VULCANIZATE PROPERTIES OF CHLOROBUTYL/SBR BLENDS*

Compound No.	13	14	15	16	17	18	19	20
Chlorobutyl	75.0	75.0	75.0	75.0	75.0	75.0	100.0	–
SBR 1500	25.0	25.0	25.0	25.0	25.0	25.0	—	100.0
TMTDS	0.15	0.15	1.0	—	—	—	1.0	0.15
MBTS	1.5	1.5	1.0	1.0	—	—	2.0	1.5
NA-22	—	—	—	1.0	—	—	—	—
Tetrone A	—	0.25	—	0.50	—	—	—	—
GDMA	—	—	—	—	1.5	—	—	—
Amberol ST 137 Resin	—	—	—	—	—	5.0	—	—
MgO (Maglite K)	—	—	1.0	—	—	—	—	—
Sulfur	2.0	—	—	—	—	—	—	3.0
ZnO	5.0	5.0	5.0	5.0	5.0	5.0	5.0	—
Original Properties Cure: 30 min./307° F.								
Tensile, psi.	2020	2540	2370	2380	2120	2370	2820	2800
Elongation, %	260	430	460	400	440	300	470	270
300% Modulus, psi.	—	1730	1540	1690	1470	—	1830	—
Hardness, Shore A	71	65	59	60	62	65	59	65
Mooney scorch, MS 260° F., T_5	13	12	13	9	3	14	8	18
Aged Properties, 72 Hrs. @ 250° F.†								
Tensile, psi.	1900	2440	2480	2020	2090	2080	2450	1730
Elongation, %	140	280	260	230	250	150	350	90
Ozone Resistance†								
Min. to crack	2	3	4	5	74	42.5	7.5	0.25
Break	10	21.5	15.5	21	97	78	42	2.5

Compound No.	21	22	23	24	25	26	27	28
Chlorobutyl	50.0	50.0	50.0	50.0	50.0	50.0	25.0	25.0
SBR 1500	50.0	50.0	50.0	50.0	50.0	50.0	75.0	75.0
TMTDS	—	0.15	0.15	0.15	—	—	0.15	1.5
MBTS	—	1.5	1.5	1.5	1.0	—	1.5	1.0
DOTG	2.0	—	—	—	—	—	—	—
Tetrone A	—	—	0.25	—	—	—	—	—
Sulfasan R	—	—	—	1.0	1.0	—	1.0	—
Amberol ST 137 Resin	—	—	—	—	5.0	5.0	—	—
Sulfur	2.0	0.5	—	—	—	—	—	—
ZnO	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Original Properties Cure: 30 min./307° F.								
Tensile, psi.	2570	2450	2240	2360	2720	2120	2940	2460
Elongation, %	480	460	530	410	570	520	470	590
300% Modulus, psi.	1650	1550	1250	1780	1480	1300	1940	1300
Hardness, Shore A	63	63	60	62	65	62	66	64
Mooney scorch, MS 260° F., T_5	30	17	12	11	16	17	8	9
Aged Properties, 72 Hrs. @ 250° F.†								
Tensile, psi.	2230	2130	2370	2440	2230	2150	2790	2880
Elongation, %	100	170	240	180	140	140	190	220
Ozone Resistance‡								
Min. to crack	—	1.5	5	1	11	25	0.33	0.33
Break	—	7.0	13	5	36	65	3.0	3.0

*Masterbatch of 100 polymer or polymer blends, one of Antioxidant 2246, 50 of HAF black, one of stearic acid used.
†Same conditions as in Table 1.

rubber vulcanizates will crack in one minute or less. (See Table 1.)

Chlorobutyl-SBR Blends

Good blend vulcanizates of chlorobutyl and SBR can be achieved by combining sulfur donors such as TMTDS, Tetrone A, or Sulfasan R with secondary accelerators such as MBTS and NA-22 (Table 3). Their quality is illustrated by elongations in excess of 400% and excellent dynamic stability during severe flexing tests. Sulfur cures display good tensile properties when primary accelerators are kept low and are combined

with generous amounts of secondary accelerators. For best results, sulfur should also be kept low, as in Compound No. 22 (0.5-phr.).

Higher sulfur levels can be tolerated when slow accelerators (DOTG), as in Compound No. 21, are used. Delayed-action accelerators such as 2-MT and Santocure (not shown), however, tend to produce lower elongations in SBR blends than in NR blends. Shorter elongation and greater hardness are produced by moderate sulfur levels (2 phr.) when accelerators are too active (No. 13). Sulfur donors yield better extensibility, but tend to produce faster scorch times when used at concentrations of 0.5-1.0 phr. (Compounds 16 and 24).

Figure 3 illustrates the effect of sulfur level and accelerators on scorch time. The compound of curve 1 is not taken from Table 3, but demonstrates the scorchiness produced by a high level of sulfur donor (Sulfasan R). Sulfur donors will yield adequate scorch safety at lower concentrations, 0.5-phr. for Sulfasan R (not shown) and 0.25-phr. for Tetrone A (Compounds 14 and 23).

Curve 2, also for a compound not included in the table, illustrates the scorch performance of a 2-phr. sulfur cure when combined with an active accelerator combination (TMTDS-MBTS). Curve 3 (Compound 22) demonstrates the increased scorch protection produced by reducing sulfur to 0.5-phr. while using the same acceleration. Even greater process safety is achieved at the 2-phr. sulfur level by using a slow accelerator (DOTG) as shown in curve 4 (Compound 21).

In aging tests carried out in a circulating air oven at 250° F., sulfur donors impart better heat resistance than sulfur cures. After 72 hours, a 50/50 blend retains a tensile strength of 2370 psi. and elongation of 240% when vulcanized with an effective sulfur donor (Compound 23). An identical low-sulfur cure (No. 22) realizes a fair 170% elongation in the same test; while a high-sulfur cure (No. 21) possesses only 100% elongation. By employing sulfur donors, good heat stability can be extended to blends containing as much as 75 phr. SBR and only 25 of chlorobutyl rubber. Tensile strengths of 2800 psi. and elongations of 200%

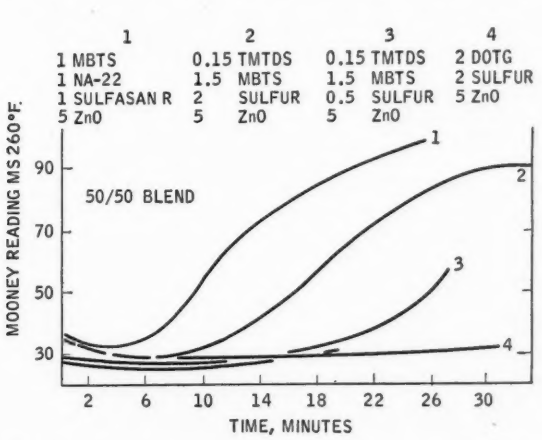

Fig. 3. Effect of cure system on Mooney scorch of chlorobutyl-SBR blends

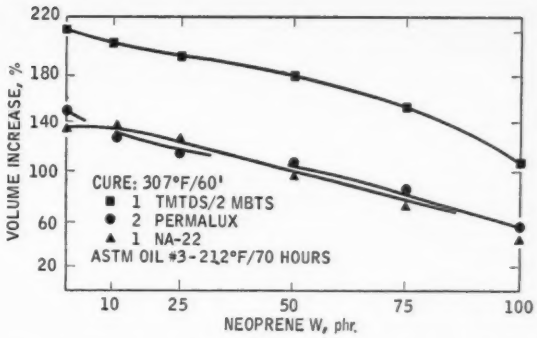

Fig. 4. Blending with neoprene improves the oil resistance of chlorobutyl rubber

after heat aging are attainable with such compounds (Nos. 27 and 28).

Chlorobutyl can tolerate 25 phr. of SBR and still maintain a high degree of ozone resistance. Even in 50/50 blends a good level of ozone resistance is retained. Sulfur-donor vulcanization imparts better ozone performance in the 75/25 blends (Compounds 14, 15, 16), but yields inconsistent ozone behavior in 50/50 blends (Compounds 23 and 24).

Additional data suggest that when SBR is a major constituent of a blend, between 30-40 phr. of chlorobutyl are required to impart improvement in ozone resistance. However, if SBR were fortified by wax and antiozonant, even better performance might be realized at these blend ratios. It has been suggested that the solubility of wax in chlorobutyl may help control the rate of bleeding and thus increase protection against ozone attack.

Recent data indicate that less conventional curatives will impart outstanding ozone resistance to blend vulcanizates. For example, a dithiol cure (glycol dimercaptoacetate) of a 75 chlorobutyl/25 SBR blend (No. 17) remains crackfree for 74 minutes, and a dimethylol phenol-formaldehyde resin cure (No. 18) for 42 minutes. To date, however, dithiols have been most effective in high chlorobutyl-content blends. The dimethylol phenol-formaldehyde resin cure, on the other hand, is effective in a 50/50 blend (No. 26) and yields a crack time of 25 minutes. These results indicate that considerable proportions of SBR can be blended to reduce cost of chlorobutyl compounds while still retaining a good level of ozone and heat resistance. Further work is needed to design cure formulations for maximum ozone resistance in blends where SBR is the major constituent.

Flexometer tests were carried out on 75 chlorobutyl/25 SBR blends since this ratio had been the most difficult to vulcanize in the earlier butyl blend studies.[3] Compounds cured with low sulfur or sulfur donors (e.g., Nos. 14, 15, 16) demonstrate excellent dynamic stability. The same severe Goodrich flexometer test mentioned with NR blends was used. Permanent set averaged about 6% with a 70° F. heat build-up. These values can be reduced by half with higher levels of sulfur donors (0.5 Tetrone A—not shown). Mooney scorch time (MS 260° F.), however, is reduced to

TABLE 4. EFFECT OF CURE SYSTEM ON STRESS-STRAIN PROPERTIES OF CHLOROBUTYL/NEOPRENE BLENDS*

Compound No.	29	30	31	32	33	34	35	36	37
Chlorobutyl	100.0	90.0	75.0	50.0	25.0	—	100.0	90.0	75.0
Neoprene W	—	10.0	25.0	50.0	75.0	100.0	—	10.0	25.0
MgO (Maglite D)	1.0	1.25	1.75	2.5	3.25	4.0	1.0	1.25	1.75
TMTDS	1.0	1.0	1.0	1.0	1.0	1.0	—	—	—
MBTS	2.0	2.0	2.0	2.0	2.0	2.0	—	—	—
Permalux	—	—	—	—	—	—	2.0	2.0	2.0
ZnO	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Original Properties Cure: 30 min./307° F.									
Tensile, psi.	2670	2480	2300	2390	2500	3010	2040	2140	1930
Elongation, %	590	580	490	390	320	330	360	280	200
100% Modulus, psi.	250	350	380	510	510	720	390	650	780
200% Modulus, psi.	730	730	850	1210	1310	1850	1030	1530	1820
Hardness, Shore A	60	64	67	67	70	74	63	69	73
Mooney scorch, MS 260° F., T_5	30+	30+	30+	20	18	10	15	10	8
Aged Properties, 72 Hrs. @ 250° F.†									
Tensile, psi.	2460	2320	2210	2310	2620	2620	1690	1640	1620
Elongation, %	330	330	280	190	160	130	120	100	90
Ozone Resistance†									
Min. to crack	5.5	4.5	4	4	3	1	5	4.5	5
Break	60+	60+	60	45	28	8	32	55	42

Compound No.	38	39	40	41	42	43	44	45	46
Chlorobutyl	50.0	25.0	—	100.0	90.0	75.0	50.0	25.0	—
Neoprene W	50.0	75.0	100.0	—	10.0	25.0	50.0	75.0	100.0
MgO (Maglite D)	2.5	3.25	4.0	1.0	1.25	1.75	2.5	3.25	4.0
Permalux	2.0	2.0	2.0	—	—	—	—	—	—
NA-22	—	—	—	1.0	1.0	1.0	1.0	1.0	1.0
ZnO	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Original Properties Cure: 30 min./307° F.									
Tensile, psi.	2210	2900	3090	2120	2030	1970	2200	2500	3280
Elongation, %	170	160	130	370	380	300	160	140	140
100% Modulus, psi.	1230	1620	2420	340	440	620	1180	1550	2000
200% Modulus, psi.	—	—	—	990	1000	1330	—	—	—
Hardness, Shore A	75	80	84	60	65	70	75	78	82
Mooney scorch, MS 260° F., T_5	‡2/7	‡2/6	—	30	30+	30+	‡6/27	‡4/11	—
Aged Properties, 72 Hrs. @ 250° F.†									
Tensile, psi.	1660	2000	1920	1870	1940	2050	2150	2350	2350
Elongation, %	80	70	50	160	150	140	100	90	90
Ozone Resistance†									
Min to crack	3	1	1	5	3	2	1.5	1.5	1
Break	21	12	4.5	43	37	25	12	13	8

*Masterbatch of 100 polymer or polymer blends, one of Antioxidant 2246, MgO as shown, 50 HAF black, one stearic acid used.
†Same conditions used as in Table 1.
‡Scorch curve has two maxima.

only four minutes. The resin cure (No. 18) exhibits excellent flexing stability with only 2% permanent set and 20° F. heat build-up. The high modulus of the 2-phr. sulfur cure (No. 13) dictated a reduction in stroke to 0.125-inch. Under these conditions this type of cure survived the 30-minute test.

Chlorobutyl-CR Blends

In vulcanizing chlorobutyl/neoprene blends, the criterion of good original elongation is difficult to achieve. TMTDS-MBTS cures result in good elongations, but NA-22 and Permalux cures yield considerably shorter elongations. In Table 4 the effect of curatives on the original and aged stress-strain properties of blends is shown. Although elongations tend to become shorter with the more active curatives, dynamic stability is still achieved. The 50/50 blends survive the severe 30-minute Goodrich flexometer test.

Neoprene blends were investigated as a means of imparting oil resistance to chlorobutyl rubber. Again the

TABLE 5. EFFECT OF OTHER CURATIVES ON VULCANIZATE PROPERTIES OF CHLOROBUTYL/NEOPRENE BLENDS*

Compound No.	46	47	48	49	50	51	52	53
Curatives†	A	B	C	D	E	F	G	H
Original Properties Cure: 30 min./307° F.								
Tensile, psi.	2280	2330	2110	2220	1980	2320	1810	2260
Elongation, %	140	190	240	150	100	190	130	160
100% Modulus, psi.	1530	1000	830	1440	—	1060	1430	1300
Hardness, Shore A	75	75	74	77	80	75	80	75
Oil Resistance‡								
Vol. Increase, %	100	114	129	105	96	131	109	111
Ozone Resistance§								
Min. to crack	5	9	9	1.5	3.5	12	2.5	3.5
Break	24	48	42	23	7.5	42	4.0	19

*Masterbatch of 50 chlorobutyl/50 neoprene, one of antioxidant 2246, 2 of MgO (Maglite K), 50 of HAF black, one of stearic acid used.

†Curatives: A, catechol; B, resorcinol; C, hydroquinone; D, phloroglucinol; E, pyrogallol; F, 1,5 dihydroxy naphthalene; G, p-phenylene diamine; H, ethylene trithiocarbonate.

‡ASTM Oil No. 3, 70 hrs. at 212° F. A Permalux cure gave 99% swell and an NA-22 cure a 117% swell in the same formulation as used for the curatives reported in this table.

§Conditions used that same as in Table 1.

cure system used is important in realizing best results. With a typical chlorobutyl-type cure (TMTDS-MBTS), a 50/50 blend (No. 32) does not achieve the desired improvement, which is not surprising since thiurams and thiazoles are weak accelerators for neoprene.

On the other hand, conventional neoprene curatives produce tightly crosslinked blends that possess a good level of oil resistance. The effect of cure system and blend ratio on oil resistance in ASTM Oil #3 after 70 hours at 212° F. is shown in Figure 4. Note that a 50/50 blend cured with Permalux (No. 38) or NA-22 (No. 44) approaches an all-neoprene compound in oil resistance.

Other accelerators similar in structure to NA-22 and Permalux were also investigated for oil resistance in blends (Table 5). Catechol (No. 46), which is a constituent of Permalux, yields properties identical to Permalux cures. Resorcinol (the meta derivative of dihydroxybenzene) (No. 47) gives about 15% greater volume increase; while hydroquinone (para derivative) (No. 48) produces about 30% greater increase. Pyrogallol (1, 2, 3 derivative) (No. 49) yields the highest modulus, but does not result in any significantly better oil resistance than catechol. p-Phenylene diamine (No. 52) is considerably better than hydroquinone and slightly better than resorcinol. Ethylene trithiocarbonate (ETTC) (No. 53), which has a structure related to NA-22, imparts better oil resistance than does NA-22, but presently suffers a cost disadvantage.

Scorch behavior with NA-22 and Permalux is shown in Figure 5. The 50/50 blend is illustrated since this was the ratio at which peaks occurred in the scorch curves. Apparently, the two polymers are not curing homogeneously. Reduction in curative concentration eliminates sharp peaks; however, maximum scorch protection occurs when MBTS or sodium acetate is added. The TMTDS-MBTS cure possesses adequate process

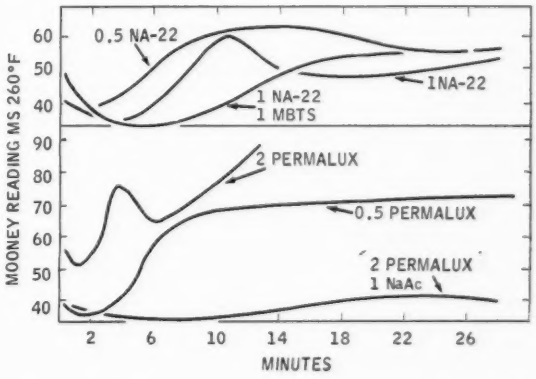

Fig. 5. Effect of cure system on Mooney scorch of chlorobutyl-neoprene blends

safety over the whole range of blends. (See Table 4.)

In spite of their high moduli, oil-resistant blend vulcanizates still achieve a good level of ozone resistance. For example, a Permalux cure of a 50/50 blend (100% modulus = 1230 psi.—No. 38) cracks in three minutes and breaks in 21 minutes in accelerated ozone tests. This is better than half the ozone resistance of an all-chlorobutyl compound (No. 35) and three times better than an all-neoprene compound (No. 40). Even better performance is realized with a resorcinol cure (Table 5) which has a crack time of nine minutes. These results indicate that it is now possible to combine both ozone resistance and oil resistance in blend vulcanizates. Such blends should be attractive, for example, in automotive parts.

The tight state of cure necessary for minimum oil swelling works against maintaining extensibility during heat aging. After 72 hours' aging at 250° F., blends

TABLE 6. PROPERTIES OF BLENDS OF CHLOROBUTYL WITH OTHER RUBBERS

Compound No.	54	55	56	57	58	59
Chlorobutyl	75.0	75.0	50.0	50.0	70.0	70.0
NBR (Paracril C[a])	25.0	25.0	—	—	—	—
BR (Cis-4[b])	—	—	50.0	50.0	—	—
Reclaimed rubber[c]	—	—	—	—	45.0	45.0
SRF black	50.0	50.0	—	—	30.0	30.0
HAF black	—	—	50.0	50.0	—	—
MT black	—	—	—	—	30.0	30.0
TMTDS	0.15	—	1.0	—	0.4	—
MBTS	1.5	—	2.0	—	1.0	—
NA-22	—	—	—	2.0	—	—
Amberol ST 137 resin	—	5.0	—	—	—	—
MgO (Maglite K)	—	—	0.5	0.5	—	—
DIOP[d]	10.0	10.0	—	—	—	—
Necton 60 oil[e]	—	—	—	—	12.0	12.0
Amberol ST 137X[f]	—	—	—	—	7.0	7.0
Stearic acid	1.0	1.0	1.0	1.0	1.0	1.0
Antioxidant 2246	1.0	1.0	—	—	—	—
PBN	—	—	—	—	1.0	1.0
Sulfur	1.0	—	—	1.0	2.0	—
ZnO	5.0	5.0	3.0	3.0	5.0	5.0
Original Properties Cure: 30 min./307° F.						
Tensile, psi.	1060	1380	2150	2480	760	830
Elongation, %	350	410	340	370	460	690
300% Modulus, psi.	950	1000	1820	1800	600	400
Aged Properties	72 hrs. @ 250° F.				7 days @ 212° F.	
Tensile, psi.	1210	1200	—	—	830	820
Elongation, %	200	170	—	—	300	170
Oil Resistance (ASTM No. 3 Oil, 70 hrs. @ 212° F.)						
% Volume Increase	173	168	—	—	—	—
				Adhesion to SBR Carcass (Lb./In.)		
				R. T	22	48
				212° F	7	20

[a] Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.
[b] Phillips Chemical Co., Akron, O.
[c] Whole tire, 51% RHC, 20% black.
[d] Dioctyl phthalate.
[e] Humble Oil & Refining Co., New York 19, N. Y.
[f] Non-heat reactive phenol-formaldehyde resin, Rohm & Haas Co., Philadelphia 5, Pa.

containing 25 phr. neoprene possess ultimate elongations of 140% when cured with NA-22 (No. 43), but only 90% elongation when cured with Permalux (No. 37). The comparable 50/50 blends have even shorter elongations. Tensile strength, however, is maintained at 1600-2000 psi. It should be noted, however, that no attempt was made in this study to compound for optimum heat resistance. Other studies, for example, have shown that minor amounts (< 10 phr.) of neoprene can have a very favorable influence on chlorobutyl's heat resistance.

Good heat stability can be realized with higher-level neoprene blends by curing with TMTDS-MBTS. A 50/50 blend (No. 32) possesses approximately 200% elongation after 72 hours at 250° F. Such blend vulcanizates also retain a good level of ozone resistance. In 0.2% ozone, crack and break times are 4 and 45 minutes, respectively.

Blends of Chlorobutyl with Other Rubbers

Screening experiments have been performed with blends of chlorobutyl and other rubbers and have uncovered some interesting preliminary results (see Table 6).

Blends of whole-tire reclaim with chlorobutyl appear to be a useful approach to cost compounding and processing. High levels of adhesion to SBR and good heat aging performance are possible with such compounds at a cost level attractive for passenger-tire inner liners.

Studies of blends with high *cis*-polybutadiene indicate that a slow accelerator-sulfur cure or a sulfur-donor cure yields substantially better tensile properties, as would be expected in our work with NR and SBR blends.

Nitrile blends yield the greatest oil resistance when cured with high sulfur levels or with dimethylol phenol-

APPENDIX

Materials Used

Trade Name	Composition	Supplier
Antioxidant 2246	2,2′-Methylene bis (4-methyl-6-tert.-butyl phenol)	American Cyanamid Co., rubber chemicals department, Bound Brook, N. J.
Catechol	o-Dihydroxybenzene	
DOTG	Di-o-tolylguanidine	
ETTC	Ethylene trithio carbonate	Evans Chemetics, Inc., New York 17, N. Y.
GDMA	Glycol dimercapto-acetate	Evans Chemetics
Hydro-quinone	p-Dihydroxybenzene	
Maglite D	Active magnesium oxide	Marine Magnesium Division, Merck & Co., Rahway, N. J.
K	Less active magnesium oxide	Marine Magnesium Division
MBT	2-Mercaptobenzothiazole	
MBTS	Benzothiazyl disulfide	
NA-22	2-Mercaptoimidazoline	E. I. du Pont de Nemours & Co., elastomer chemicals department, Wilmington, Del.
Permalux	Di-o-tolylguanidine salt of dicatechol borate	Du Pont elastomer chemicals department
Pyrogallol	1,2,3-Trihydroxybenzene	
Resin	Dimethylol phenol-formaldehyde condensation product	Amberol ST137, Rohm & Haas Co., Philadelphia 5, Pa.
Resorcinol	m-Dihydroxybenzene	
Santocure	N-Cyclohexyl-2-benzo-thiazolesulfenamide	Monsanto Chemical Co., rubber chemicals department, Akron, O.
Sulfasan R	4,4′-Dithiodimorpholine	Monsanto rubber chemicals department
Tetrone A	Dipentamethylene-thiuram tetrasulfide	Du Pont elastomer chemicals department
TMTDS	Tetramethylthiuram disulfide	
TPG	Triphenylguanidine	
2-MT	2-Mercaptothiazoline	American Cyanamid rubber chemicals department

formaldehyde resin. Further adjustments in cure are necessary, however, since tensile strength is considerably lower than in either polymer alone. Heat aging experiments reveal good tensile retention and also fair extensibility.

Summary and Conclusions

The compatibility of chlorinated butyl rubber opens the way for combining the stability, damping properties, and low permeability of a butyl-type polymer with the low-temperature properties and processing advantages of natural rubber, the abrasion resistance of polybutadiene, the oil resistance of neoprene and nitrile rubbers, and the cost advantages of SBR and reclaim. Curatives markedly influence the quality of the blends. Natural rubber and SBR blends give maximum tensile properties when cured with the following vulcanization systems:

(1) Sulfur donor with secondary accelerators.
(2) Low sulfur with primary and secondary accelerator.
(3) High sulfur with slow accelerators.

The sulfur-donor cures yield best aging properties. Chlorobutyl-neoprene blends produce maximum oil resistance with neoprene-type curatives, but achieve maximum heat resistance with chlorobutyl-type curatives. Potential applications for the wide scope of blends range from inner tubes, tubeless tire liners, white sidewall tires, and weather-resistant veneers to non-transport items such as hoses, belts, molded goods requiring some degree of heat, ozone, and oil resistance with good damping and low-temperature properties.

Acknowledgment

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■

Rubber Road Program

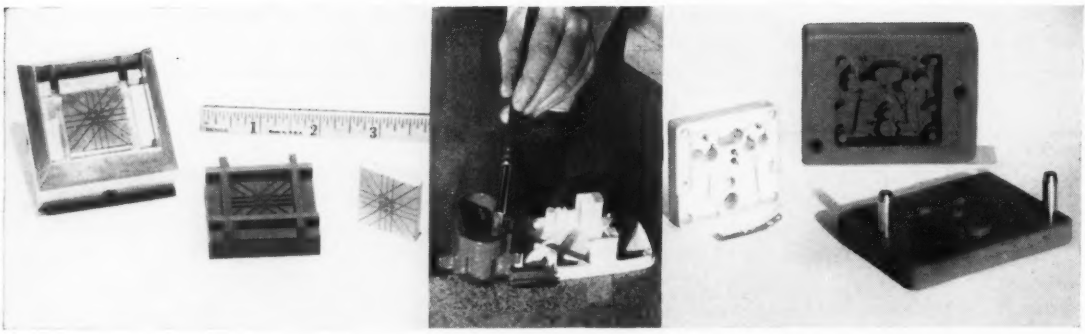
The State of Massachusetts is now rehabilitating some of its older roads by resurfacing with a blend of SBR crumb together with hot asphalt and aggregate. The material, Naugapol 3112, is a product of Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

Better than 30 miles of roads were resurfaced last year by the new technique, and work has now begun on four projects which were not completed last year, according to Naugatuck. Contracts have just been let for five additional resurfacing jobs.

According to Naugatuck, as little as 3% of the crumb added to asphalt produces paving mixes with greater resistance to stripping, bleeding, rutting, and low-temperature impact than standard asphalt, road and laboratory tests show. In addition, the mix does not dry out so quickly, and a riding surface of only ½- to ¾-inch of the new material is needed, in contrast to 1¼ inches of standard paving mixes. Where only a thin resurfacing was required, a ⅜-inch thickness of the polymer blended asphalt and aggregate was used.

A number of programs are being carried out throughout the United States and elsewhere in the world to get better road surfaces through use of the rubber-asphalt mixes. Polymers used include SBR crumb, natural rubber crumb, natural rubber latex, neoprene latex, and reclaim crumb. Proponents of the so-called "rubber roads" say they so far outwear asphalt that it is hard to run comparison tests.

Cheaper Molding of Prototype Parts



In precision operations, use of RTV silicone can eliminate expensive multi-piece rigid molds. *Left*, an RTV mold makes possible inserting a fixture with a high degree of precision and accuracy. *Right*, an RTV two-piece mold makes possible exactness without expensive jig boring operations. *Center*, mold is applied by filling cracks or pores in the master pattern and painting or spraying the surface with liquid silicone rubber.

ROOM-TEMPERATURE vulcanizing (RTV) silicone rubbers offer the rubber fabricator a chance to produce prototype parts quickly and at comparatively low cost.

When making prototype rubber parts, the fabricator is faced with two choices, neither very satisfactory in many cases. He may choose a rigid mold, which can be made in one piece only for the simplest parts. For more complex parts the mold must be made in several pieces, with knockout pins and perhaps with a number of inserts. Such molds are expensive to build, and they take considerable time to make when time is often at a premium.

His other choice is to use a flexible mold, which often has excessive shrinkage and poor surface reproduction and needs a parting agent and a high-temperature cure. At the same time such a mold often lacks sufficient heat resistance for making rubber parts which themselves need high-temperature cures.

According to the silicone products department of General Electric Co., one of two manufacturers of RTV silicones (the other is Dow Corning Corp.) RTV molds eliminate most of the disadvantages of flexible molds. The advantages of RTV silicones:

Low Shrinkage—less than 0.2%

No Parting Agent—the silicone is non-stick, saving time and expense in applying and cleaning up parting agents.

Superior Detail—faithful reproduction of even the most intricate details from the model.

Rapid Cure—anywhere from 10 minutes to 24 hours, depending on the catalyst used.

High-Temperature Resistance—resistance to temperatures as high as 600° F., allowing curing of most rubbers in the mold.

Quantity Production—because of RTV strength and release ability, several dozen models can be cast from the same mold.

Versatility—viscosity ranging from pourable liquid to a thick paste allows application to objects of virtually any size or shape.

Although figures are not available on production of rubber parts, considerable savings have been made when RTV molds were used for plastics. In the case of an aluminum-filled cast epoxy drum with four cross-holes, the cost of machining the plastic would have been $75 per part in lots of 10. By using RTV the cost was cut to $5 per part. In another case cost of coil winding forms was cut from $86 a pair to $16, and time of making the forms was cut from three weeks to two days. In still another case, an assembly fixture used in assembling motor switch components cost $175 each, but an RTV mold cost less than $50 and the parts $10 each.

The technique of using RTV silicone molds is obviously not applicable in all cases, since it cannot be used for stiff compounds which require pressure molding. But in cases where pressure is not needed, such as use with pourable urethane rubbers, it may be worth while for a fabricator to see whether the method is applicable to his particular problem.

Low-viscosity compounds are particularly suited for picking up intricate details, undercuts, deep draws and so on, and the high viscosity compounds where stiffness is required, as in large parts. For parts where both qualities are needed, a low viscosity compound can be used on the face of the master pattern, and the high-viscosity compound as a back-up material. In order to obtain the maximum number of parts from a mold, RTV silicone molds can be cured under heat and air pressure, as in an autoclave or pressure vessel.

Available Dry Synthetic Rubbers Except SBR–II[1]

Isobutylene-Isoprene (IIR)

Enjay Butyl 035

COMP: Isobutylene-isoprene copolymer.
SUP: Enjay Chemical Co.
PHY PROP: Solid block or bale of about 55 lbs. wrapped in polyethylene film. Sp. gr., 0.92. Light-amber color. Mooney viscosity, 41-49.
PROC PROP: Slowest curing grade due to its low unsaturation.
VUL PROP: Recommended for maximum ozone resistance. Requires quinoid cure for best results. Used for medium and high-voltage insulation.

Enjay Butyl 150

COMP: Isobutylene-isoprene copolymer.
SUP: Enjay Chemical Co.
PHY PROP: Solid block or bale of about 55 lbs. wrapped in polyethylene film. Also available in coated cartons as Enjay Butyl 150-CC. Sp. gr., 0.92. Light-amber color. Mooney viscosity, 41-49.
PROC PROP: Slightly more unsaturation and therefore faster curing than Enjay Butyl 035.
VUL PROP: Has good ozone resistance and excellent chemical resistance.

Enjay Butyl 165

COMP: Isobutylene-isoprene copolymer with non-staining stabilizer.
SUP: Enjay Chemical Co.
PROP: Non-staining grade equivalent to Enjay Butyl 150. Also available in coated cartons as Enjay Butyl 165-CC.

Enjay Butyl 215

COMP: Isobutylene-isoprene copolymer.
SUP: Enjay Chemical Co.
PHY PROP: Solid block or bale of about 55 lbs. wrapped in polyethylene film. Also available in coated cartons as Enjay Butyl 215-CC. Sp. gr., 0.92. Light-amber color. Mooney viscosity, 41-49.
PROC PROP: Medium unsaturation allows rapid cure with sulfur and standard accelerators.
VUL PROP: Suggested where use of plasticizer must be kept to a minimum. Has good ozone and chemical resistance.

Enjay Butyl 217

COMP: Isobutylene-isoprene copolymer.
SUP: Enjay Chemical Co.
PHY PROP: Solid block or bale of about 55 lbs. wrapped in polyethylene film. Also available in coated cartons as Enjay Butyl 217-CC. Sp. gr., 0.92. Light-amber color. Mooney viscosity, 61-70.
PROC PROP: Same unsaturation and cure rate as Enjay Butyl 215, but higher Mooney viscosity.
VUL PROP: Similar to lower viscosity butyl of same unsaturation.

Enjay Butyl 218

COMP: Isobutylene-isoprene copolymer.
SUP: Enjay Chemical Co.
PHY PROP: Solid block or bale of about 55 lbs. wrapped in polyethylene film. Also available in coated cartons as Enjay Butyl 218-CC. Sp. gr., 0.92. Light-amber color. Mooney viscosity (ML 3 min. at 260° F.), 50-60.
PROC PROP: This is the "standard" grade of Enjay Butyl. Has the same unsaturation and cure rate of Enjay Butyl 215. Has the highest Mooney viscosity. Commonly compounded with up to 25 parts of oil.
VUL PROP: High viscosity makes this grade useful for such products as inner tubes and extrusions. Has typical butyl resistance to permeability of gases, ozone, weathering, heat, chemicals, tear, and abrasion along with good electrical properties. Other properties include low compression set, good compression flexing, and excellent color retention.

Enjay Butyl 268

COMP: Isobutylene-isoprene copolymer with non-staining stabilizer.
SUP: Enjay Chemical Co.
PROP: Non-staining grade equivalent to Enjay Butyl 218. Also available in coated cartons as Enjay Butyl 268-CC.

Enjay Butyl 325

COMP: Isobutylene-isoprene copolymer.
SUP: Enjay Chemical Co.
PHY PROP: Solid block or bale of about 55 lbs. wrapped in polyethylene film. Sp. gr., 0.92. Light-amber color. Mooney viscosity (ML 8 min. at 212° F.), 41-49.
PROC PROP: Highest in unsaturation; therefore fastest cure rate. Same Mooney viscosity as Enjay Butyl 035, 150, and 215.
VUL PROP: Recommended for maximum heat resistance.

Enjay Butyl 365

COMP: Isobutylene-isoprene copolymer with non-staining stabilizer.
SUP: Enjay Chemical Co.
PROP: Non-staining grade equivalent to Enjay Butyl 325. Also available in coated cartons as Enjay Butyl 365-CC.

Enjay Butyl HT Series

COMP: Chlorinated isobutylene-isoprene copolymer.
SUP: Enjay Chemical Co.
PHY PROP: Solid bale. Sp. gr., 0.92. Mooney viscosity (ML 8 min. at 212° F.), 50-60. Dark-amber color. Formerly MD-551.

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[1] Continued from our May, 1961, issue, p. 79.

PROC PROP: Has fast cure rates with both conventional cures as well as newer-type vulcanization systems. It is compatible with NR, SBR, CR, and IIR.

VUL PROP: It is outstanding in heat resistance with ability to withstand up to 400° F. It is also good in resistance to compression set, permeability of gases, tear, chemicals, oxidation, and ozone. Exhibits good compression flexing properties.

Polysar Butyl 100

COMP: Isobutylene-isoprene copolymer.

SUP: Polymer Corp., Ltd.

PHY PROP: Sp. gr., 0.92. Contains staining stabilizer. Mooney viscosity (ML 8 at 212° F.), 45. Unsaturation 0.7 mol. %.

PROC PROP: Slow-curing grade due to low unsaturation.

VUL PROP: Best of the grades for ozone resistance with good heat aging properties. Used for high-voltage wire and cable.

Polysar Butyl 101

COMP: Isobutylene-isoprene copolymer.

SUP: Polymer Corp., Ltd.

PHY PROP: Sp. gr., 0.92. Contains no stabilizer. Mooney viscosity, (ML 8 at 212° F.), 60. Unsaturation, 0.7 mol. %.

PROC PROP: Slow-curing grade due to low unsaturation.

VUL PROP: Recommended for food and drug applications.

Polysar Butyl 200

COMP: Isobutylene-isoprene copolymer.

SUP: Polymer Corp., Ltd.

PHY PROP: Sp. gr., 0.92. Contains staining stabilizer. Mooney viscosity, (ML 8 at 212° F.), 45. Unsaturation, 1.4 mol. %.

PROC PROP: Intermediate curing characteristics.

VUL PROP: Slightly improved heat-aging properties and less ozone resistance than the 100 series. Used for special electrical applications.

Polysar Butyl 300

COMP: Isobutylene-isoprene copolymer.

SUP: Polymer Corp., Ltd.

PHY PROP: Sp. gr., 0.92. Contains staining stabilizer. Mooney viscosity, (ML 8 at 212° F.), 45. Unsaturation, 1.8 mol. %.

PROC PROP: Intermediate curing characteristics.

VUL PROP: Medium resistance to ozone and heat of Polysar Butyls. Used for low-voltage wire for both insulation and jackets.

Polysar Butyl 301

COMP: Isobutylene-isoprene copolymer.

SUP: Polymer Corp., Ltd.

PHY PROP: Sp. gr. 0.92. Contains non-staining stabilizer. Mooney viscosity, (ML 8 at 212° F.), 75. Unsaturation, 1.6 mol. %.

PROC PROP: Higher viscosity due to higher molecular weight. Medium cure rate.

VUL PROP: General-purpose IIR with intermediate heat and ozone resistance properties.

Polysar Butyl 400

COMP: Isobutylene-isoprene copolymer.

SUP: Polymer Corp., Ltd.

PHY PROP: Sp. Gr., 0.92. Contains staining stabilizer. Mooney viscosity, (ML 8 at 212° F.), 45. Unsaturation, 2.2 mol. %.

PROC PROP: Fastest curing grade of Polysar IIR.

VUL PROP: Has excellent resistance to heat with still good ozone resistance.

Polysar Butyl 402

COMP: Isobutylene-isoprene copolymer.

SUP: Polymer Corp. Ltd.

PHY PROP: Sp. gr., 0.92. Contains non-staining stabilizer. Mooney viscosity, (ML 8 at 212° F.), 45. Unsaturation, 2.2 mol. %.

PROC PROP: Same as Polysar Butyl 400.

VUL PROP: Same as Polysar Butyl 400 except non-staining for use in light-colored goods.

Nitrile-Butadiene Rubbers (NBR)

Butaprene NAA

COMP: Butadiene-acrylonitrile copolymer with a medium-high acrylonitrile content.

SUP: Xylos Rubber Co.

PHY PROP: Light-amber colored. Supplied in 50-lb. bales, or milled and boxed, 75 lb. Sp. gr., 1.00. Mooney range (ML-4 at 212° F.), 50-70.

PROC PROP: Easy-processing polymer requiring little or no breakdown period. Can be used with low plasticizer ratios with excellent results.

VUL PROP: Medium to high oil and fuel resistance with medium cold resistance. Normal physical properties are good. Can be compounded for minimum stain.

Butaprene NF

COMP: Butadiene-acrylonitrile copolymer with a low acrylonitrile content.

SUP: Xylos Rubber Co.

PHY PROP: Light-amber colored. Supplied in 50-lb. bales, or milled and boxed, 75 lb. Sp. gr., 0.98. Mooney range 30-50.

PROC PROP: Easy-processing polymer requiring little or no breakdown period.

VUL PROP: Fair oil resistance with excellent cold resistance. Normal physical properties are good. Can be compounded for minimum stain.

Butaprene NH

COMP: Butadiene-acrylonitrile copolymer with a very high acrylonitrile content.

SUP: Xylos Rubber Co.

PHY PROP: Light-amber colored. Supplied in 50-lb bales, or milled and boxed, 75 lb. Sp. gr., 1.04. Mooney range (ML-4 at 212° F.), 40-60.

PROC PROP: An exceptionally easy-processing polymer with very high nitrile content. Has very low nerve or recovery.

VUL PROP: Has the highest fuel or oil resistance of the NBR polymers, but because of its high nitrile content it has the least cold flexibility resistance. Normal physical properties are fair. Hardness is high with normal filler loadings. It can be compounded for minimum stain.

Butaprene NL

COMP: Butadiene-acrylonitrile copolymers with a medium acrylonitrile content.

SUP: Xylos Rubber Co.

PHY PROP: Light-amber colored. Supplied in 50-lb. bales, or milled and boxed, 75 lb. Sp. gr., 0.99. Mooney range, 50-70.

PROC PROP: Easy-processing polymer requiring little or no breakdown period. Can be used with low plasticizer ratios with excellent results. Outstanding extrusion qualities.

VUL PROP: Medium oil and fuel resistance and good cold resistance. Normal physical properties are good to excellent. Also available as a non-staining polymer .

Butaprene NXM

COMP: Butadiene-acrylonitrile copolymer with a high acrylonitrile content.

SUP: Xylos Rubber Co.

PHY PROP: Light-amber colored. Supplied in 50-lb. bales, or milled and boxed, 75 lb. Sp. gr., 1.01. Mooney range (ML-4 at 212° F.), 80-100. Also available in Mooney range of 50-70.

PROC PROP: Easy-processing polymer requiring little or no breakdown before adding ingredients.

VUL PROP: Excellent fuel and oil resistance with fair cold resistance. Normal physical properties are good to excellent. Can be compounded for minimum stain.

Chemigum N1NS

COMP: Butadiene-acrylonitrile copolymer. 32-33% acrylonitrile.

SUP: The Goodyear Tire & Rubber Co.

PHY PROP: Sp. gr., 0.98. Mooney plasticity, 115 max. Antioxidant, non-staining. Color, beige. Odor, mild and pleasant. Storage stability, excellent.

PROC PROP: Can be processed on standard equipment.

VUL PROP: A medium nitrile polymer. Was the original Goodyear oil-resistant rubber. Has been revised and modified to produce better polymer for most applications. Mainly used for a few specialty items.

Chemigum N3NS

COMP: Butadiene-acrylonitrile copolymer. 42-43% acrylonitrile.

SUP: The Goodyear Tire & Rubber Co.

PHY PROP: Sp. gr., 1.00 Mooney plasticity, 87-112. Solubility in MEK, 65%. Antioxidant, non-staining. Color, beige. Odor, mild and pleasant. Storage stability, excellent.

PROC PROP: Can be processed on standard equipment. It is heat softening and does not toughen during milling and mixing.

VUL PROP: Outstanding resistance to solvents and fuels with high tensile strength, elongation, modulus, and crescent tear. Recommended for high-quality compounds for O-rings, seals, and other molded parts.

Chemigum N5 (Cement Grade)

COMP: Butadiene-acrylonitrile copolymer. 42-43% acrylonitrile.

SUP: The Goodyear Tire & Rubber Co.

PHY PROP: Sp. gr. 1.00. Mooney plasticity, 87-112. Solubility in MEK, 77%. Antioxidant, non-staining. Color, beige. Odor, mild and pleasant. Storage stability, excellent.

PROC PROP: May be processed on standard cement or adhesive making equipment.

VUL PROP: Cement-grade counterpart of Chemigum N3NS. Has excellent solubility. For use in cements and adhesives with excellent stability.

Chemigum N6

COMP: Butadiene-acrylonitrile copolymer. 32-33% acrylonitrile.

SUP: The Goodyear Tire & Rubber Co.

PHY PROP: Sp. gr,. 0.98. Mooney plasticity, 40-65. Solubility in MEK, 96%. Antioxidant, non-staining. Color, light tan. Odor, mild and pleasant. Storage stability, excellent.

PROC PROP: Has very good processability on standard equipment.

VUL PROP: Exhibits good physical properties. Provides exceptional resistance to greases, oils, fats, solvents, and fuels. Has excellent compression set properties and is designed to meet the SB and SC compounds of ASTM/SAE specifications.

Chemigum N6B

COMP: Butadiene-acrylonitrile copolymer. 32-33% acrylonitrile.

SUP: The Goodyear Tire & Rubber Co.

PHY PROP: Sp. gr., 0.98. Mooney plasticity 40-65. Solubility in MEK, 82%. Antioxidant, non-staining. Color, light cream. Odor, mild and pleasant. Storage stability, excellent.

PROC PROP: Similar to Chemigum N6.

VUL PROP: Similar to N6, but with improved antioxidant system for service in non-discoloring and non-staining applications including colored compounds.

Chemigum N7

COMP: Butadiene-acrylonitrile copolymer. 32-33% acrylonitrile.

SUP: The Goodyear Tire & Rubber Co.

PHY PROP: Sp. gr. 0.98. Mooney plasticity 77-102. Solubility in MEK, 60%. Antioxidant, non-staining. Color, light, tan. Odor, mild and pleasant. Storage stability, excellent.

PROC PROP: Slightly more difficult than easy-processing Chemigums, but can be processed on standard equipment.

VUL PROP: One of the toughest medium acrylonitrile rubbers available. Its higher viscosity and lower solubility make its use valuable in compounding to precise specifications.

Chemigum N8

COMP: Butadiene-acrylonitrile copolymer. 32-33% acrylonitrile.

SUP: The Goodyear Tire & Rubber Co.

PHY PROP: Sp. gr. 0.98. Mooney plasticity, 75-102. Solubility in MEK, 30%. Antioxidant, non-staining. Color, creamy-white. Odor, mild and pleasant. Storage stability is said to be excellent.

PROC PROP: An outstanding processing NBR. Can be used alone for processing and low die swell or blended with other Chemigums to improve processability. It is excellent for use in extruding and calendering operations.

VUL PROP: It exhibits typical resistance to oils and fuels of the medium nitrile rubbers.

Chemigum N300

COMP: Butadiene-acrylonitrile copolymer. 42-43% acrylonitrile.
SUP: The Goodyear Tire & Rubber Co.
PHY PROP: Sp. gr., 1.00. Mooney plasticity, 57-75. Solubility in MEK, 98%. Antioxidant, non-staining. Color, white. Odor, mild and pleasant. Storage stability, excellent.
PROC PROP: Exhibits the improved processability of cold polymerized nitrile rubber. Has excellent solution properties.
VUL PROP: Produces high physical properties of cold-type polymer. It has approximately no gel and gives clear solutions easily. Can be used for dry compounding or for solution compounding.

Chemigum N600

COMP: Butadiene-acrylonitrile copolymer. 32-33% acrylonitrile.
SUP: The Goodyear Tire & Rubber Co.
PHY PROP: Sp. gr., 0.98. Solubility in MEK, 99%. Antioxidant, non-staining. Color, beige. Odor, mild and pleasant. Storage stability, excellent.
PROC PROP: Has easy processability with improved scorch resistance. Compounds exhibit excellent mold flow characteristics.
VUL PROP: Has the higher physical properties of cold-type polymer. Gives compounds with very low water swell along with typical oil and fuel resistance of medium NBRs.

Chemivic 400

COMP: Acrylonitrile-butadiene copolymer reinforced by vinyl resin.
SUP: The Goodyear Tire & Rubber Co.
PHY PROP: Supplied as 100-lb. slabs in corrugated box. Sp. gr., 1.08. Mooney viscosity (ML—4′ at 212° F.), 50 ± 10.
PROC PROP: Can be compounded and processed on standard equipment.
VUL PROP: General-purpose polymer designed for molding, extruding, and calendering.

Chemivic 800

COMP: Acrylonitrile-butadiene copolymer reinforced by vinyl resin.
SUP: The Goodyear Tire & Rubber Co.
PHY PROP: Supplied as 100-lb. slabs in corrugated box. Sp. gr., 1.08. Mooney viscosity (ML—4′ at 212° F.), 88 ± 10.
PROC PROP: Can be compounded and processed on standard equipment.
VUL PROP: Specialty polymer developed for extrusions and calendering. Used for operations where low die swell and minimum of mill shrinkage are required for quality end-product.

Hycar 1000 x 88

COMP: Butadiene-acrylonitrile copolymer with very high acrylonitrile content. Has AgeRite Stalite as antioxidant.
SUP: B. F. Goodrich Chemical Co.
PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 1.00. Mooney viscosity, 65-95.
PROC PROP: Can be processed on standard equipment.
VUL PROP: Excellent oil resistance. Similar to Hycar 1001, but has slightly higher acrylonitrile content.

Hycar 1000 x 132

COMP: Butadiene-acrylonitrile copolymer with very high acrylonitrile content. Has AgeRite Stalite as antioxidant.
SUP: B. F. Goodrich Chemical Co.
PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 1.00. Mooney viscosity, 45-65.
PROC PROP: Can be processed on standard equipment.
VUL PROP: Exceptionally high oil and fuel resistance. For applications such as transformer gaskets and fuel lines.

Hycar 1001

COMP: Butadiene-acrylonitrile copolymer with high acrylonitrile content. Has AgeRite Stalite as antioxidant.
SUP: B. F. Goodrich Chemical Co.
PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 1.00. Mooney viscosity, 80-110. This is the original Hycar rubber.
PROC PROP: Can be processed on standard equipment.
VUL PROP: Excellent oil and fuel resistance.

Hycar 1002

COMP: Butadiene-acrylonitrile copolymer with medium-high acrylonitrile content. Has AgeRite Stalite as antioxidant.
SUP: B. F. Goodrich Chemical Co.
PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 0.98. Mooney viscosity, 75-110.
PROC PROP: Can be processed on standard equipment.
VUL PROP: Very good oil resistance. Excellent water resistance. Affords best water resistance of all Hycar NBR polymers.

Hycar 1014

COMP: Butadiene-acrylonitrile copolymer with low acrylonitrile content. Has AgeRite Stalite as antioxidant.
SUP: B. F. Goodrich Chemical Co.
PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 0.95. Mooney viscosity, 70-90.
PROC PROP: Easy processing.
VUL PROP: Fair oil resistance. Excellent low-temperature properties.

Hycar 1022

COMP: Butadiene-acrylonitrile copolymer with medium-high acrylonitrile content, and non-staining antioxidant.
SUP: B. F. Goodrich Chemical Co.
PHY PROP: Slabs supplied in 100-lb. cartons. Sp. gr., 0.98. Mooney viscosity, 45-70.
PROC PROP: Low Mooney viscosity. Directly soluble, cement-grade polymer.
VUL PROP: Very good oil resistance. Used in adhesives. Also used in molded, calendered, and extruded goods requiring low processing viscosities and relatively low moduli.

Hycar 1041

COMP: Butadiene-acrylonitrile copolymer with high acrylonitrile content. Has AgeRite Stalite as antioxidant.
SUP: B. F. Goodrich Chemical Co.
PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 1.00.

Mooney viscosity, 70-95. Low temperature polymerized.

PROC PROP: Easy processing. Provides better processing and building tack than does Hycar 1001 for friction stock and any similar application.

VUL PROP: Excellent oil resistance properties.

Hycar 1042

COMP: Butadiene-acrylonitrile copolymer with medium-high acrylonitrile content. Has AgeRite Stalite as antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 0.98. Mooney viscosity, 70-95.

PROC PROP: Low-temperature polymerized, easy-processing rubber. Excellent solubility, milled and unmilled.

VUL PROP: Very good oil resistance.

Hycar 1042 x 69

COMP: Butadiene-acrylonitrile copolymer with medium-high acrylonitrile content, and non-staining antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 0.98. Mooney viscosity, 70-95. Non-staining and non-discoloring.

PROC PROP: Low temperature polymerized, easy processing. Excellent solubility, milled and unmilled.

VUL PROP: Very good oil resistance. Non-staining, non-discoloring.

Hycar 1043

COMP: Butadiene-acrylonitrile copolymer with medium acrylonitrile content, and non-staining antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 0.97. Mooney viscosity, 70-95.

PROC PROP: Easy processing. Low-temperature polymerized rubber.

VUL PROP: Good oil resistance. Good low-temperature properties.

Hycar 1051

COMP: Butadiene-acrylonitrile copolymer with a high acrylonitrile content. Has AgeRite Stalite as antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 1.00. Mooney viscosity, 60-85.

PROC PROP: Superior processing type of Hycar 1001. Provides good processing and building tack for friction stocks and similar applications.

VUL PROP: Excellent oil resistance.

Hycar 1052

COMP: Butadiene-acrylonitrile copolymer with medium-high acrylonitrile content and non-staining antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 0.98. Mooney viscosity, 45-70.

PROC PROP: Low Mooney, easy-processing type of Hycar 1042.

VUL PROP: Very good oil resistance. Provides compounds with high elongation.

Hycar 1053

COMP: Butadiene-acrylonitrile copolymer containing a medium acrylonitrile content, and non-staining antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 0.97. Mooney viscosity, 45-70.

PROC PROP: This is an easier processing variety of Hycar 1043.

VUL PROP: Good oil resistance. Good low-temperature properties.

Hycar 1072

COMP: Butadiene-acrylonitrile copolymer with medium-high acrylonitrile content and non-staining antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Slabs supplied in 50-lb. bags. Sp. gr., 0.98. Mooney viscosity, 35-60. Hycar 1042 modified with carboxyl groups.

PROC PROP: Can be cured with zinc oxide alone or conventional groups.

VUL PROP: Very good oil-resistant properties. For oil-resistant mechanical goods with improved low-temperature brittleness, hot tear, and outstanding abrasion resistance.

Hycar 1203

COMP: Prefluxed blend of 70% Hycar nitrile rubber, and 30% Geon poly(vinyl chloride) resin. Hycar 1203 contains non-staining antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Slabs supplied in 85-lb. drums. Sp. gr., 1.07. Mooney viscosity, 80-105.

PROC PROP: This Hycar can be processed on standard equipment.

VUL PROP: Excellent oil and weather resistance.

Hycar 1312

COMP: Butadiene-acrylonitrile copolymer with medium-high acrylonitrile content, and a non-staining antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Liquid supplied in 55-gal. drums. Sp. gr., 0.98. Liquid-type Hycar 1002.

PROC PROP: Can be cured to hard rubber state. Plasticizer for NBR compounds requiring improved flow and knitting. Valuable in plastisols and liquid phenolic resin blends.

VUL PROP: Very good oil resistance.

Hycar 1411

COMP: Butadiene-acrylonitrile copolymer with high acrylonitrile content. Has AgeRite Stalite as antioxidant.

SUP: B. F. Goodrich Chemical Co.

PHY PROP: Powder supplied in 130-lb. drums. Sp. gr., 1.00. Mooney viscosity, 100-130.

PROC PROP: Finely divided powder version of Hycar 1001. Not soluble. Phenolic resin modification. Blends with other Hycar rubbers to improve smoothness of extrusions and calendered stock.

VUL PROP: Excellent oil-resistant properties.

(To be continued)

Non-Sulfur Curing Systems Outlined

Four types of non-sulfur curing systems, sulfur donor, magnesium oxide, peroxide, and resin systems, were outlined, April 28, at the meeting of the Philadelphia Rubber Group. Approximately 85 persons attended the technical session at the Poor Richard Club, Philadelphia, Pa., and 160 the dinner following.

Morton J. Kalins, an account executive for Bache & Co., after dinner spoke on investments.

Peroxide Cures Discussed

Lyle O. Amberg, research chemist in the plastics and elastomers division of Hercules Powder Co., Wilmington, Del., explained that two of the major fields for peroxide cures are in cross-linking saturated polymers such as ethylene-propylene and vinyl acetate polymers, and in curing polyethylenes.

He noted that peroxides can be classified into two broad groups, those whose decompositions into radicals can be accelerated or retarded by other chemicals, and those which are responsive only to changes in temperature. The first group, which includes the carbonyl peroxides such as benzoyl peroxide and most hydroperoxides, is not likely to be of general interest, since these materials are very susceptible to many of the rubber compounding ingredients, such as carbon blacks, metal oxides, and amines, he said.

In the second group, which includes the alkyl and aryl peroxides such as di-tert-butyl peroxide and dicumyl peroxide, no significant cure occurs after about four half-life periods, the time it takes for half of the peroxide to decompose at a given temperature, this speaker declared. This amounts to halving the curing time for each 10° C. rise in temperature as with sulfur cures, he explained. Thus, diene rubbers cured with dicumyl peroxide, with a half life of about 13 minutes at 300° F., are fully cured in 45-50 minutes at that temperature.

Besides vulcanizing chemically saturated polymers, peroxide cures may be used with conventional rubbers to give improved color and discoloration resistance, as well as improved aging resistance and low-temperature properties, he said.

Amberg noted, however, there are some important differences between peroxide and sulfur cures. Peroxide cures can be used at temperatures higher than the upper limits for most organic accelerators and are not practical in free air, since oxygen reacts vigorously with hydrocarbon free radicals. In addition, a peroxide cure has a tendency to depolymerize certain highly branched polymers such as polyisobutylene and butyl rubber, he said.

In compounding, he noted, many materials react with peroxides, with mineral pigments increasing peroxide demand in proportion to the increases in acceleration required when such pigments are used in sulfur cured rubber. This is more true of channel blacks than furnace and thermal blacks. When acid materials such as acidic clays are being used, it is usual to include an alkaline material such as triethanolamine or an active grade of magnesium oxide to compensate.

Paraffinic or naphthenic plasticizers or extenders and antioxidants which react with peroxides also increase peroxide demand. The antioxidant reaction increases peroxide demand and consumes the antioxidants to some degree. Because of this action, it may be preferred to surface coat peroxide cured rubber with an antiozonant rather than incorporate the antiozonant into the compound before curing, Amberg explained.

Use of MgO Cures

William H. Crom, manager of the Marine Magnesium Division of Merck & Co., Rahway, N. J., delivered a paper by William H. Deis, manager of Merck's rubber laboratory, on use of magnesium oxide in curing systems for halogenated rubbers.

Deis noted that in curing neoprene, magnesium oxide is a vulcanizing agent through reaction with tertiary allylic chlorine to form ether linkages, also promoting vulcanization by organic accelerators; an acid acceptor during processing, curing, and aging; and a mild peptizer which reduces plasticity. It improves aged properties, increases cure rate after an initial retarding action, and increases scorch protection and improves bin storage, he said. For Merck magnesium oxides, scorch times increase with increasing iodine number, leveling off above an iodine number of 80.

At 10 minutes cure, modulus and tensiles are the same for all types of Merck magnesium oxides, and at longer cure times the highest modulus is obtained with the most active magnesium oxide. Maximum scorch protection combined with minimum cure index time is obtained with about 4 parts per hundred of MgO, he said.

In "Hypalon," Deis said, magnesium oxide crosslinks the polymer by reacting with sulfonic acid groups, affords the most heat-resistant compounds when used in combination with litharge, improves weathering of white and light-colored stocks, and serves as an acid acceptor during processing, curing, and aging.

Increased surface activity gives less or slightly less scorch protection, particularly in epoxy cures, a faster cure rate with the same ultimate tensile strength, and comparable changes during high temperature aging, he went on. With 50-50 blends of "Hypalon" 20 and natural rubber, 10 phr. of active magnesium oxide gives better heat aged properties than less active types.

In fluoroelastomers, Deis said, magnesium oxide is a catalyst for removal of hydrogen fluoride during vulcanization, and an acid acceptor during processing, curing, and aging. Magnesium oxide results in a high state of cure and by absorbing released hydrogen fluoride, provides better properties after heat aging.

High-activity magnesium oxide gives higher original tensile strength and elongation and higher compression set than lower-activity types and gives less loss of elongation, but greater tensile loss after heat aging. As a result, high-activity magnesium oxide is best suited for fabric reinforced articles where retention of flexibility or elongation after heat aging is critical, but a magnesium oxide of intermediate to low activity gives the best balance of properties for most uses.

For use with black chlorobutyl compounds magnesium oxide is an acid acceptor, giving longer scorch times, a retarded or slightly retarded cure rate, and sometimes better aged properties. Maximum scorch protection is afforded

with increased levels of magnesium oxide of higher surface activity, with some sacrifice of cure rate. It should be used with certain curing systems in Banbury mixes and in those mill mixes where heat history is significant. 1-2 phr. of MBTS increases the effectiveness of MgO as an anti-scorch agent while offsetting its tendency to retard cure rate. In addition, magnesium oxide improves tensile strength or elongation retention of many compounds during high-temperature aging.

In non-black chlorobutyl compounds magnesium oxide provides curative and promoter effects for many cure systems, but in combination with 1-2 phr. of MBTS, it has a synergistic retarding effect on Mooney scorch. In certain compounds it gives a better balance of properties than zinc oxides. In some compounds it can replace Elastopar to obtain similar stress-strain properties with longer scorch times, and without heat treating. It also improves the weather resistance of most white compounds.

With brominated butyl, magnesium oxide can be used in combination with zinc oxide to provide improved aged properties. When used along with a Glycol Dimercapto acetate cure, it gives a good aging, but rather scorchy compound.

For peroxide cures, magnesium oxide gives white natural rubber compounds with superior aging and weathering properties and in general gives improved physical properties by making the cure system more basic, which results in more efficient utilization of free radicals; the effects are evident with acidic and some basic fillers.

Sulfur Donor Cures

R. T. Zimmerman, manager of the dry rubber department of R. T. Vanderbilt Co., discussed the use of sulfur donor materials such as the tetramethyl and tetraethyl thiuram disulfides for obtaining improved heat aging properties in rubbers. The use of tetramethyl thiuram disulfide provides fast cures and should be used with zinc oxide and a fatty acid for maximum efficiency, he explained. Tetraethyl thiuram disulfide gives slightly longer vulcanization times and slightly softer vulcanizes for equal weights of the curing agent. It has approximately 11% available sulfur compared to 13% for the methyl derivative. A blend of the two minimizes bloom, he said, adding that addition of .1-1 part of selenium or tellurium to the compound reduces bloom while enhancing heat resistance of the vulcanizate.

Zimmerman said that the single atoms of sulfur formed by breakdown of the sulfur donor materials conceivably react with a greater number of reactive terminal bonds than would normally react with elemental sulfur atoms, leaving a minimum of reactive double bonds available for attack by oxygen. It is also possible that there are some direct carbon bonds formed between chains due to free radical mechanism in addition to the carbon to sulfur to carbon bonds, thus cutting down on the number of reactive double bonds which might be attacked by oxygen.

Zimmerman noted that another sulfur donor material commonly used is dipentamethylene thiuram tetrasulfide, which has an available sulfur content of about 25%. It is quite rapid in its action and because of high sulfur content can be used in lesser quantities than tetramethyl thiuram disulfide to produce similar vulcanizates. Another material is 4-4′-dithiomorpholine, which contains 27% available sulfur and, when used from 2-5 parts per 100 rubber hydrocarbon, is quite effective either when used alone or in combination with thiuram disulfides.

The speaker further declared that alkyl phenol disulfides, of which the two on the market contain 23 and 28% of available sulfur respectively, may be used in quantities of 3-10 phr. alone or in smaller quantities in combination with the thiuram disulfides.

Other materials include: aliphatic polysulfide polymers, which can be used alone; selenium dimethyl dithiocarbamates, with 14% of available selenium, and selenium diethyl dithiocarbamate, with 11%, which provide good heat aging, especially with SBR, when used in 2-4 phr.; and tellurium diethyl dithiocarbamate, with 18% tellurium, which is widely used as an accelerator with sulfur, since its action is too mild and slow for general use as a curing agent.

The speaker outlined the history of sulfur donor materials, from the use of sulfur monochloride vapor in 1846, the use of antimony pentasulfide and antimony trisulfide the following year (it was actually found that the antimony sulfides contained a high amount of elemental sulfur and thus were not actually sulfur donors at all), the discovery process for reaction of sulfur dioxide with hydrogen sulfide in 1918, the development in 1925 of room temperature vulcanization with a solution of sulfur monothiocyanate and sulfur dithiocyanate in carbon disulfide, and the use of lead thiosulfate for vulcanizing rubber clothing. The processes have found little use, he noted.

Zimmerman said that many other materials might be used as sulfur donors, depending on cost, availability of raw materials, processing characteristics, and properties of the vulcanizate.

Resin Cure of Butyl

Paul Viohl, senior research scientist at the United States Rubber Co. research center in Wayne, N.J., discussed vulcanization of butyl rubber with 2,6-dimethylol-4-hydrocarbylphenol condensation resins. He said he preferred to theorize that vulcanization takes place on the basis of chromane ring formation rather than on a structure arrived at by the removal of an active hydrogen atom from an isoprene unit in the butyl chain.

Dr. Viohl explained that catalysts play a dual role in the vulcanization reaction, increasing not only the rate of vulcanization, but also the ultimate state of vulcanization.

The best catalysts for the curing of butyl rubber with resins are metallic halides such as tin chloride, zinc chloride, and ferric chloride; however, metallic halides of this type are strongly acidic and tenderize textile materials, he warned. This reaction led United States Rubber to develop 2-2′-methylene-bis-(4 chloro-6-methylolphenol), a chemical that vulcanizes butyl at a practical rate without requiring acidic catalysts.

Other resins that have appeared recently are Schenectady Resin SP-1055, a 2,6-dimethylol-4-hydrocarbylphenol resin modified with small amounts of hydrogen bromide, and Union Carbide Plastic Co.'s GRRA-0803 resin, described as "a new heat-advancing alkyl phenol resin designed as a curing agent for butyl rubber," he said.

B. S. Garvey, Jr., director of the rubber service laboratory for Pennsalt Chemicals Corp., was moderator during the technical discussion.

Tlargi Meetings

Bradford R. Voight, assistant manager of the process engineering division of Farrel-Birmingham Co., Inc., discussed automation of rubber mill room operations at the monthly technical session of The Los Angeles Rubber Group, Inc., on May 2. The meeting and the dinner following were held at the Biltmore Hotel, Los Angeles, Calif. Joseph Walker, dinner speaker, discussed his experiences as chief test pilot for the National Aeronautics & Space Administration's X-15 rocket plane project.

Voight explained that in order to achieve optimum production in a rubber plant, it is necessary to integrate storage, proportioning, mixing, batch-out, and finishing operations.

In storage, feeding, and weighing, one master control system may control all functions and, in addition, may control the mixer, a batch-out extruder, and the cooling line, he added. Several types of control systems are available, from completely programmed to highly flexible manual selection.

Where consumption warrants the installation, bulk handling may produce savings, the speaker said. Dry bulk materials may be conveyed from storage to weigh hoppers and discharged directly to the mixer, and liquids may be pumped from tanks and metered directly through an injection nozzle into the mixing chamber, he explained.

In addition, he further declared, quality is the only measure of a calendering operation, and good quality is a function of precise control applied to well-designed precision equipment.

Voight also noted that a thorough

study should be made before undertaking an automation project, determining production, marketing, and financial considerations before going into the technical aspects of the project.

At the April 4 meeting, held at the Hotel Lafayette, Long Beach, Calif., chlorinated butyl rubber was discussed by A. S. Banks, project leader in sales and technical service for Enjay Chemical Co.

Banks explained that chlorination enables butyl to be vulcanized by a variety of cure systems in order to obtain a wide range of properties, and making it possible to blend it with other rubbers such as natural rubber, SBR, neoprene, or nitrile rubber. Innerliners, white sidewalls, weather-resistant veneers for SBR tires, hose, conveyor belts, and molded items requiring some degree of heat, ozone, and oil resistance in combination with good damping and low-temperature properties have been commercially made with Enjay Butyl HT 10-66 blends, he said.

Buffalo and Ontario Annual Joint Meeting

The need of diversification and a speed-up in the time needed to get a new product to market were the subjects of the only speech at the annual joint meeting of the Buffalo and Ontario Rubber groups held at the Sheraton Brock Hotel, Niagara Falls, Ont., Canada, May 12.

Willard Cheek, senior research physicist, General Motors Corp. research laboratories, gave the after-dinner talk entitled, "The Ropes of the Past Ring the Bells of the Future." Dr. Cheek emphasized the necessity of research and development people working together in close contact to reduce the time lag between discovery and application. He used demonstrations of light-sensitive materials, territes, and semiconductors to emphasize his points. He also pointed out that while total rubber consumption is increasing in the United States, tire rubber consumption is leveling off, and that this indication should be a sign to the tire companies to broaden their fields.

Washington RG Meets

The Washington Rubber Group at its last business meeting of the season, May 17, elected Thomas A. Tharp president for the 1961-62 year. Tharp, district manager of the General Tire & Rubber Government and Aviation Division, succeeds Philip Mitten.

Main speaker at the May 17 meeting was E. Leonard Borg, of Naugatuck Chemical Division, United States Rubber Co. His talk, "Stereo-Regular Synthetic Rubber," was illustrated with slides and brought the Group up-to-date on these new rubbers, discussing their typical properties and characteristics as well as their uses.

Short Talks Symposium at Boston

The final meeting, and Short Talks Symposium, of the Elastomer & Plastics Group, Northeastern Section, ACS, was held on May 16 at Science Park, Charles River Dam, Boston, Mass., with 125 present to hear four speakers on as many subjects, and to enjoy the usual preprandial refreshment, discussions, and catered dinner that preceded the technical session.

The meeting was opened by Chairman Henry A. Hill, consultant, and turned over to the Short Talks Symposium Chairman, Chester Mijal, UBS Chemicals, Inc., who introduced the speakers in turn.

Infrared Analysis

The first speaker, Leonard Shapiro, Beacon Chemical Industries, Inc., discussed "Infrared Analysis of Polymers" from the experimental analysis point of view. After defining the common terms used in infrared analysis, the speaker explained in non-technical terms how the energy absorption effects are reflected in sample behavior in the analytical equipment, and how the curve resulting from the energy absorption measurements reflected the reaction of specific chemical structures in the sample and made possible their identification. The characteristic curves for specific structures and compounds were discussed and illustrated, and the application of the method to the examination of unknowns was shown with results secured on polystyrene, polyethyl acrylate, and other esters.

Polymer Education Program

The second speaker of the evening was Henry Merken, Polyvinyl Chemicals, Inc., who described a plant personnel education program of his company in a paper titled, "Lecture Series on Polymerization, Designed for Plant Personnel — Why and How." This program, non-technical in plan and intended for average plant employes lacking formal chemical education, was designed to be presented monthly, one hour for each shift during working hours. Production workers substituted for each other during course periods by reporting early to cover the other shift's duties.

Subjects covered in the course included: introduction; products prepared in the plant and their inherent properties; uses of the products prepared in the plant; polymerization (definitions, initiation, propagation, termination, copolymerization); emulsion polymerization (ingredients and their purposes); advantages of emulsion polymerization; methods of polymer preparation; variables encountered in emulsion polymerization; comparison of polymerization systems (bulk, solution, suspension, and emulsion); and a concluding review session. No quizzes were used, but slides were found very useful. Considerable experimentation was necessary to reduce the language complexity to a level easily understood by the employes. Use of models, especially poppet beads in several colors, proved very helpful.

Mr. Merken gave portions of several of the lectures in illustration of the type of presentation employed in the series. The course was enthusiastically received, and it is intended to offer review lectures in the future. Several of the employes expressed a desire to continue their education in a more formal manner.

Water-Soluble Polymers for Coating

The third symposium speaker, Norwin Wolff, UBS Chemical Co., spoke on "Water-Soluble Polymers in the Surface Coating Industry." This field is expected to consume 135-145 million gallons of latex by 1964, he said. Just as emulsions provide certain advantages over solvent solutions in safety and in handling, so do soluble polymer solutions offer advantages over both of these former materials. Among the advantages given were ease of cleaning of equipment, lack of hazards, low costs, quick drying, low toxicity, and also higher gloss, stability, better adhesion and leveling properties.

Disadvantages given for this system were the necessity of evaporating water and the high heat requirements involved, the possibility of blister formation if all moisture is not removed, difficulties met in wetting metal surfaces, and the raising of grain in some substrates of wood or composition materials. The speaker also touched upon the high shear stability of these films, which require no emulsifiers; he told of their lack of thixotropy, for they exhibit dilatancy; and in speaking of setup time, which is slower than other films, he stated that present-day polymers are not satisfactory in all respects.

Present practice includes addition of a soluble polymer to an emulsion polymer, in the approximate ratio of 25-75, which results in the space between emulsion particles being filled with particles from the solution polymer, on drying. The resulting film is improved. Polystyrene latex, normally not a film-former from emulsion, can be used as such in conjunction with an alkali-soluble resin, in which the styrene particles become embedded. The resulting film is a glossy architectural paint. To improve the water-resistance of such films, they are baked, using enough lyophilic groups, such as COOH, OH, amino or amido groups, as crosslinking sites. Peroxides accomplish crosslinking.

The future of this field lies in development of room-temperature crosslinking of these films, and the speaker

was confident that before long such finishes would replace the solvent and the latex-bases types.

Mechanism of Film Formation

The final speaker of the evening was William F. Scheufele, Dewey & Almy Chemical Division, W. R. Grace & Co., who discussed the "Mechanism of Film Formation from Latices." Discussion of the size of particles and areas of surface and the distribution of emulsifiers in these systems indicated more information was needed to determine the actual part each of the factors play in the film-forming act.

Measurements were made of the degree of consolidation of films by determing elongation at break of films dried at room and at elevated temperatures. Smaller particle size produced higher consolidation indices for vinyl acetate polymers and copolymers, but time-dependent changes occurred with acrylic and styrene-butadiene copolymer latices, indicating crosslinking took place.

Hydrolysis in strong alkali was employed with ester-type polymers (acrylic esters and vinyl acetate polymers) and showed that degree of consolidation correlated with hydrolysis resistance.

In the examining of emulsifier role, the quantitative measurement of water-whitening with a reflectometer, and limiting degree of swelling in water were determined, and qualitative results were deduced to show the heterogeneity of the film, and the possible state of emulsifier residue "islands" in the film, as well as the bloom effects associated with some of these agents.

The influence of substrates was also considered, in particular, the effects they have on film continuity through influences on absorption rate of water, emulsifiers, and resin, and on the chemical effects they exert through extraction into the forming film. Application of coatings to plasterboard panels variously treated was shown in illustration of the effects resulting with soluble calcium coatings.

An active question period followed the talks, which had the largest attendance in the 11 years of the Group's history.

The next meeting of the Elastomer & Plastics Group will be October 17, speaker and subject to be announced.

Chicago RG Meetings

A panel on the prós and cons of the flashless molding process and a repeat of the 1961 Goodyear Medal Lecture were the respective technical features of the last two meetings of the Chicago Rubber Group.

Flashless molding was discussed at the March 10 meeting held in the Furniture Club, with one of the largest crowds in the Group's history taking part. The session was opened by H. F. Jurgeleit, United States Rubber Co., with a prepared paper, "The Development of Injection Molding and the Flashless Molding Process for Rubber and Rubber-Like Materials." Dr. Jurgeleit's talk, profusely illustrated with slides, covered the stages of development and the present state of the art which are covered by United States patent No. 2,883,704, issued April 28, 1959, to United States Rubber Co.

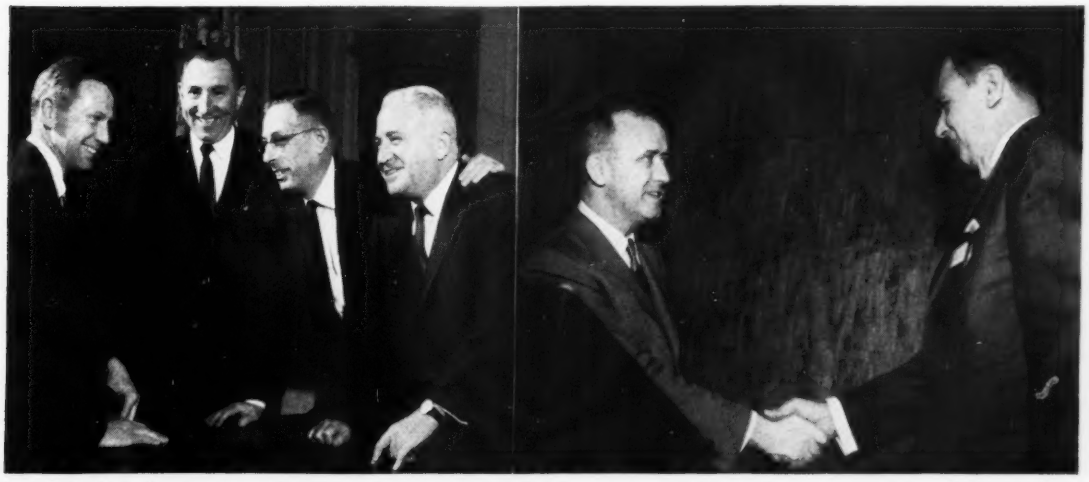
After using his slides and running commentary to discuss the various types of injection molding presses and transfer-type molds, the speaker went into the idea of making the molds locally deflectable. Under this principle, the mold cavity and the top plate are made deflectable around the individual cavity lands, and by distributing the clamping pressure on the mold uniformly over the top surface of the mold, to afford uniform land pressure on all cavity lands. Thus the cavities in a multiple-cavity mold would perform as single-cavity molds and produce flashless parts.

Following this talk the panel, composed of Moderator Albert Breckel, Victor Mfg. & Gasket Co.; Stanley H. Holmes, Stanley H. Holmes Co.; Edward O. Meisner and H. A. Sannes, both of Chicago Rawhide Mfg. Co.; and Bert Vandermar, Acadia Synthetic Products Co., presented answers to questions which had been submitted in advance. The panel stressed that with proper design and control, injection and flashless molding could produce quality parts, often with considerable cost savings.

At the April 28 meeting, also at the Furniture Club, H. A. Winkelmann, Dryden Rubber Division, Sheller Mfg. Co., delivered his 1961 Goodyear Medal Lecture on "Coatings for Rubber." (See RUBBER WORLD, May, 1961, page 87.)

Other special features of this April

(*Continued on page 111*)



Oscar & Associates, Inc.

New Chicago Rubber Group officers are *(left to right)* Robert Kann, Theodore Argue, Harold Stark, and Stanley Shaw

Frank Taylor being awarded life membership in the Chicago RG by outgoing president, Stanley Choate *(left)*

washington report

By JOHN F. KING

Firestone's Larabee Warns Congress That Aid for Liberia Is Essential

The House Foreign Affairs Committee early in May heard a first-hand report from a Firestone executive on what his firm is doing to promote U.S. foreign policy objectives while earning money in the Republic of Liberia in Africa.

The executive, Byron H. Larabee, president of Firestone Plantations in Liberia, ticked off an impressive list of community and national services the firm has provided in Liberia over the years. But the main point of his testimony was devoted to telling the Committee what the U. S. Government must do — and must do quickly — to protect its own interests in the West African nation.

Democratic Course in Danger

The present Liberian regime of President William V. Tubman is struggling to steer a democratic, pro-American course, Larabee said, but it is under increasing pressure to adopt a neutralist foreign policy and more totalitarian internal policies "to get things done in the country."

Better-educated Liberians are visiting leftist-leaning Guinea, Liberia's next-door neighbor, and returning "impressed with what is being done" under Sekou Toure's more authoritarian methods of running a nation, Larabee declared.

One of the "great tragedies" of Liberia today, he added, was that the present government, made up of men in the 35-55 age group, lacks technical and administrative proficiency. The coming generation of Liberians who are being educated either in Liberia or in other countries, he warned, is being impressed on the other hand with the "get-things-done" methods of totalitarianism.

Larabee was invited to testify before the Foreign Affairs Subcommittee on Africa, headed by Rep. Barratt O'Hara (Dem., Ill.), which has begun an investigation of what the U. S. Government needs to do to encourage a greater flow of private capital to African nations. The Subcommittee approaches the subject in the full knowledge that the violent upheavals that have wracked the Dark Continent with the onset of independence is scaring off life-giving private investment. With Larabee one of the opening-day witnesses on May 8, the O'Hara Subcommittee intends to hold a series of hearings into the summer.

Long-Term Loans Needed

Asked by Subcommittee members what action the U. S. Government should take to shore up the democratic and pro-Western government in Liberia, Larabee said long-term low-interest loans for economic development would be the most effective step. He added that outright grants of aid would probably be required in improving Liberian education (whose needs he described as a "bottomless barrel"), health facilities, and agriculture.

Noting that the United States has never granted Liberia any economic aid — despite the "special responsibility" of this country to aid the Republic which it helped set up in 1847 when former American slaves were repatriated and established in a colony on Africa's West Coast — Larabee said that "we ought to look after our friends at least as well as we look after our former enemies." That amount of aid the U. S. has extended to Liberia through military grants and loans for economic projects "has barely scratched the surface," he added.

Rep. Horace Seely-Brown (Rep., Conn.) called attention to the fact that the high level of investment in Liberia by Firestone and, more recently, by an iron-ore consortium of free-world steel companies might account for the ability of the U. S. Government to "get by" in Liberia without extending foreign aid. Larabee's answer was that the time is long past when the U. S. Government could afford to ignore Liberia's aid needs.

Discussing Firestone's operations in Liberia since the 1920's, Larabee said the firm has a planting agreement with the Liberian Government under which Firestone has the right to acquire a million acres of rubber-growing land under title to Liberia, which Firestone then leases back. Firestone has so acquired 200,000 acres, of which 90,000 are in rubber cultivation now. Actually, he said, only 63,000 acres are now in active production, since the company's replanting program has idled some 25,000 acres.

Firestone Services Described

In operating this acreage, Firestone provides jobs for between 22,000 and 27,000 Liberians and, thereby, homes for 50,000. The company operates a hospital; provides, for community service, 12 physicians who are backed up by 20 Western technicians and some 300 Liberian technicians; until 1955, when it sold out to The First National City Bank of New York, it operated the only bank in the country; it has provided schools and teachers for 2,200 children and has underwritten community and athletic clubs for its employes.

In addition, Larabee continued, Firestone acts as agent for a number of commercial firms doing business in Liberia; has introduced the only cash crops (coffee, cocoa, and indigenous food crops) harvested in the country; and set up in business for themselves 2,000 local Liberian rubber farmers.

Larabee said Firestone "has had its differences with the Tubman Government" such as the government's criticism of Firestone for not using enough Liberian personnel in higher positions. But the government and the company generally get along, mainly, he indicated, because the government has sought to maintain democratic institutions in the country.

"These democratic standards may not be the same kind as we have in Akron or Cleveland," he said. "But they are democratic standards nonetheless, standards which are non-existent in the rest of Africa."

Highway Tax Fight Shifts To Senate

The rubber industry's efforts to get a highway tax and construction program more to its liking shifted to the Senate in May after the House passed a compromise bill which contained a few of the things the industry wanted.

Whether the House bill contained enough attractions for the industry to offset its disappointment with higher taxes voted on tires, tubes, and tread rubber is doubtful. Higher rubber taxes, however, were almost a foregone conclusion when the House took up the bill, so that the offsetting attractions, thin as they are, may have to suffice for consolation.

What the House bill did, in a fashion that the Rubber Manufacturers Association had recommended, was to transfer from the General Fund an additional 5% of the 10% federal excise tax and put it into the Highway Trust Fund, which finances road construction under the 41,000-mile highway program. By adopting this policy, the House avoided imposing higher taxes on diesel fuel, large trucks, and tread rubber.

In the case of tread rubber, the Kennedy Administration had requested that the current 3¢-per-pound federal levy be boosted to 10¢. The House Ways & Means Committee compromise, accepted by the House when it passed the bill May 4, set the new tax on tread rubber at 5¢ a pound. It also boosted the tax on highway tires from 8¢ to 10¢ per pound and the inner-tube levy from 9¢ to 10¢ per pound, as requested by the Administration.

Given the chance when the Senate takes up the bill, the RMA will tell the Finance Committee that diversion of more of the federal excise tax from the General Fund to the Highway Trust Fund should enable the program to proceed without raising user taxes, as the House bill would do. RMA's position is that the diversion approved by the House will shift only $150 million and that if the diversion is increased to permit another $150 million to go into the Trust Fund, the user-tax increases could be avoided.

The National Tire Dealers & Retreaders Association, which was aghast at the Kennedy plan to boost the tread rubber tax from 3¢ to 10¢ a pound, says of the compromise 5¢ tax approved by the House that "the fight is not over yet."

FDA to Answer RMA Petition by July 1

The Rubber Manufacturers Association, Inc., won a round in its long battle with the Food & Drug Administration to get clearance for a list of compounding ingredients used in rubber products sold to the food industry.

The achievement — simply getting FDA formally to accept RMA's January 3 petition listing the compounding ingredients for which the industry sought a clean bill of health — may seem insignificant. Taken in the context of the long-drawn-out negotiation with FDA over the tremendously complex food additive issue, however, the industry scored a solid gain.

What comes next will determine whether RMA won a battle, but lost the war, or whether in fact it is getting somewhere at last. In accepting the petition April 19, FDA gave itself 90 days — up to 180 days if additional data are requested — either to issue the long-sought bill of health or deny the petition out of hand.

The lengthy petition, modified earlier in April at FDA's suggestion, includes a list of recommended compounding ingredients with established tolerances; data establishing that the intended ingredients—substances which might "migrate" out of the rubber food-handling equipment into the food itself and thereby constitute a harmful "food additive" — are, in fact, safe; details on testing procedures by which RMA established the safety of the listed ingredients; and a full report of investigations made by 12 companies under the leadership of RMA's special committee on food additives.

The cause of all this back and forth, in case anyone has forgotten, was the Food Additives Amendment of 1958, which stated that after March, 1960, harmful additives, direct or indirect additives, would be prohibited. It was in the indirect additive classification that the rubber industry, supplier of hundreds of products used in the food and beverage industry, found itself on the spot to prove that rubber compounding ingredients inadvertently introduced into the food itself were safe for human consumption.

Last September 1, FDA granted rubber manufacturers an extension from the sanctions of the bill if their products were manufactured from a specific list of compounding materials which was published in the *Federal Register* of that date. This extension is in effect until July 1, 1961, by which time RMA should have some idea whether the FDA will approve or deny its petition.

Higgins New Chief of BDSA's Rubber Branch

James H. Higgins, former sales executive for Seiberling Rubber Co. in Akron, has joined the Commerce Department as Chief of the Rubber Branch in the Chemical & Rubber Division of the Department's Business & Defense Services Administration.

He succeeds S. Earle Overley, long identified with the rubber industry, with

James H. Higgins

service both in government and in the industry. Overley, who was 71 in March, originally retired from BDSA's rubber branch a year ago, but he was persuaded to return because the Department was unable to find a replacement with his experience.

Overley, who commuted 100 miles roundtrip from his home in Fredericksburg, Va., to the Department each day, joined the government in 1942. He served in the Commerce Department, then the old National Production Authority, and in 1953 joined BDSA where he was known as one of the government's top rubber industry experts. Prior to government service, he was with the Goodyear Tire & Rubber Co. from 1912 to 1927, when he joined the Sinclair Refining Co., and then, prior to joining the government, was in business for himself.

Prior to his 12 years with Seiberling, Higgins was Assistant Director of Operations for the Office of the Rubber Director in Washington during World War II. Before that he was associated with Goodyear.

Higgins, 52, is widely known as a contract bridge player. For several years he pursued this hobby as bridge editor of the *Akron Beacon Journal*.

Goodyear and General Sign URW Contracts

The United Rubber Workers Union late in April and May settled agreements with two more major companies — Goodyear and General Tire & Rubber — which feature the newest wrinkle in industry labor settlements: a new contract plus substantial wage benefits that differentiate between tire and non-tire workers.

Pioneering this type of settlement were the pacts URW worked out in March with Firestone and United States

(*Continued on page 111*)

industry news

Atomic Reactor Uses Silicone Rubber Seals

Three silicone rubber seals, designed, developed, and fabricated by the Detroit Silicone Rubber Co., Detroit, Mich., in cooperation with Union Carbide Corp., silicones division, New York, N. Y., are being used in the new $80-million Fermi Breeder Reactor at Lagoona Beach, Mich.

Silicone rubber proved to be the only elastomeric material that could maintain its properties when exposed to temperatures up to 530° F., neutron bombardment, and such highly reactive substances as sodium and nitric acid.

Enrico Fermi Atomic Power Plant will serve as a prototype for future breeder-type installations. It is financed by two non-profit groups, Atomic Power Development Associates, Inc., which includes 30 electric power companies and 12 engineering, manufacturing, and other firms, and Power Reactor Development Co., which includes 14 electric power companies and seven manufacturing firms. Atomic Power is responsible for the power reactor research, design, development, and testing, and Power Reactor is taking care of the actual construction of the reactor part of the plant and will eventually own and operate this portion. Detroit Edison Co. has built a 150,000-kilowatt steam turbine-generator facility near the reactor plant to utilize the steam produced by the nuclear facilities for commercial electric power production.

The reactor and complete primary heat exchange system are housed in a gastight building which serves as a containment vessel. It is 120 feet high, 72 feet in diameter, and is constructed of steel of one-inch average thickness, which weighs 750 tons. Within the building, loading and unloading of the reactor core and breeder blanket are accomplished from above by a handling system that consists of a rotating shield plug and an offset handling mechanism. The top of the reactor vessel, including the handling mechanism and a control and scam rod mechanism, is covered by a dome above the concrete floor level.

The power apparatus over the sunken atomic pile contains two of the silicone rubber seals. There is a rotating seal 10 feet in diameter on which the reactor shield plug and servicing mechanism slide for changing reactor rods twice a week. A second reactor vessel seal, 20 feet in diameter, isolates the area under the reactor vessel dome from the argon-filled containment vessel or building proper. An argon atmosphere within the building is used to eliminate the possibility of air accidentally reaching and reacting with the hot sodium, the heat transfer medium. Finally, a third external seal, 71 feet and 2 inches in diameter, seals the building at ground level from the outside air.

Seventy-one feet and two inches in diameter, this silicone rubber seal is used to seal outside diameter of floor of reactor containment vessel

Before the silicone rubber was chosen as the material for the seals, it had to maintain its properties under the following conditions: at a temperature of 400° F.; under neutron bombardment; under attack by dilute nitric acid; in steam at 250° F.; after immersion in 300° F. sodium for two hours; after subjection to sodium vapor for two hours at 460° F. followed by six hours at 500° F.; after exposure to 530° F. sodium for eight hours; after exposure to 500° F. sodium for 35 minutes followed by withdrawal directly into air; after subjection to burning sodium; and after exposure to open flame.

The result of the research was a specially formulated rubber incorporating Union Carbide KW-1300 silicone rubber-base compound. The rotating seal was made from a 10-foot extrusion of the rubber. Its cross-section includes two feather edges at the top and a bulky bottom section. The 20-foot diameter reaction vessel seal was molded from the silicone rubber on a Dacron backing, for added strength or body. The containment vessel seal was molded in sections from the rubber on a Dacron and coated Fiberglas backing. The cross-section of this large seal was designed to make allowances for the expansion and contraction of the cement floor.

In addition to the three seals, there are at least 50 other applications of silicone rubber in the Fermi Breeder Reactor. For instance, there are silicone rubber seals on the apparatus used to remove the sodium pump when it is necessary.

Safety Foundation Awards Grants

The Automotive Safety Foundation, an organization supported by business and industry, has awarded grants, totaling $650,000 to 23 organizations and universities to promote safe and efficient highway transportation.

The National Safety Council received $129,000 for its Annual Inventory of Traffic Safety Activities in which state and municipal programs are compared with nationally accepted standards.

The American Bar Association was awarded $10,000 for its traffic court improvement program; the General Federation of Women's Clubs, $10,000 for traffic safety campaigns; and the National Congress of Parents & Teachers, $5,000 to prepare traffic safety material for local PTA groups.

Yale University received $67,500, in addition to ten fellowships, to train traffic engineers. The Northwestern University Traffic Institute and the International Association of Chiefs of Police were awarded $54,600 each.

The grants also included $153,000 to the Auto Industries Highway Safety Committee, $13,500 to the President's Committee for Traffic Safety.

General Tire Opens New Retreading Shop

The General Tire & Rubber Co. has opened another complete Kraft retreading shop with modern equipment for servicing all types of tires, compact, standard passenger, truck, and earthmover, in Chicago, Ill.

The new plant will service the area of Illinois, western Michigan, western Indiana, Wisconsin, Minnesota, eastern North and South Dakota, Iowa, and northwestern Missouri.

4,400,000

MILES*

* That's how far we've gone (in actual road test tire miles to date) to prove that the new Cabot REGAL oil furnace carbon blacks are nothing less than revolutionary in boosting performance and lowering costs.

WHAT THE 4,400,000 TIRE MILE TEST PROVES ABOUT THE NEW REGAL BLACKS

REGAL 300: it outperforms premium-priced channel blacks – and it doesn't cost as much

Regal 300 provides rubber properties virtually identical with those of premium-priced channel blacks, but with the faster curing rates of furnace blacks. It is an ideal lower cost replacement for channel black, offering the additional advantage of the economies of oil furnace manufacture. And, in both car and truck tire road tests, it has actually outperformed channel blacks in resistance to wear and tear, cracking and chipping.

REGAL 600: it combines new properties – better traction

This is a totally new type of oil furnace black developed by Cabot to give low hardness and low modulus in passenger car tire treads and tread rubber for a quieter ride and superior traction. Road tests prove it combines these features with excellent tread wear resistance. Its unusual combination of fine particle size and very low structure is a property never before available in oil furnace grades. It has been tested in cold SBR, oil-extended SBR and natural rubber and it offers interesting product improvement possibilities not available from either gas-produced or other oil furnace blacks.

REGAL SRF: it has two big advantages over gas-produced SRF

Regal SRF matches gas-produced SRF in performance. Thorough laboratory and plant testing shows it is interchangeable with gas-produced SRF, giving equal physical properties and processing characteristics. Yet, unlike gas-produced SRF, Regal SRF offers two important advantages because it is made from oil: 1) More convenience for carbon black users the world over, since it can be produced at locations where there is no natural gas and is commercially available from both domestic and overseas Cabot plants. 2) Price will not be affected by constantly rising costs of natural gas because Regal SRF is made from oil. Regal SRF is available at local currencies, meaning overseas users need no longer import SRF in exchange for U. S. dollars. The result: greater convenience in ordering, faster and more efficient delivery.

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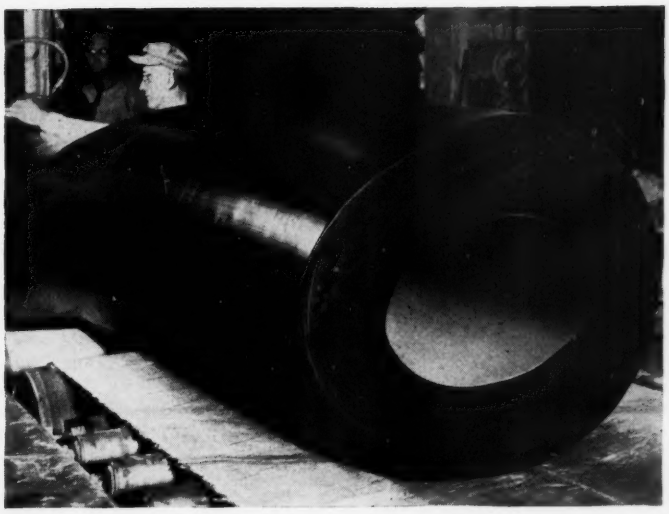


Marine dock fenders, 24-inch tubes of synthetic rubber, produced by The Goodyear Tire & Rubber Co., Akron, O., are being used to meet the needs of the harbor at Corpus Christi, Tex. Weighing 175 pounds per lineal foot, the fenders will absorb up to 52,000 foot pounds of kinetic energy per foot of length, transmitting relatively small amounts of thrust to the dock. Produced in 8- and 12-foot lengths for the Corpus Christi installation these fenders will take a thrust of more than 300,000 pounds per lineal foot at full compression without damage

■ ■ ■

United States Rubber Co., footwear plant, Naugatuck, Conn., has permanently loaned a desk, inkwell, three gold-headed canes, and several other mementos from the personal effects of Charles Goodyear to the Naugatuck Historical Society, which plans to preserve them in the community's historical museum after several exhibits in community store windows. U. S. Rubber got the mementos because Goodyear was a member of the board of directors of the Samuel J. Lewis Co. of Naugatuck, which was said to be the first company to utilize vulcanization successfully on a commercial basis. The firm is now a part of U. S. Rubber

Lee H. Clark

L. H. Clark Retires

Lee H. Clark, group vice president-East, Pennsalt Chemicals Corp., Philadelphia, Pa., has retired after 32 years of combined service with Pennsalt and with Sharples Chemicals, Inc., before it became a part of Pennsalt. In 1955 he was appointed vice president in charge of administrative services for Pennsalt; and in 1960 he was named group vice president-East, responsible for chemical specialties, industrial chemicals-East, and international operations.

Clark, a chemical engineering graduate of Cornell University, first was employed by the National Sugar Refining Co. and then by General Chemical Co., where he served as chief chemist from 1923 to 1929. That year he joined Sharples as plant manager and vice president of production. In 1950, he became executive vice president, and in 1954 he was made president.

Clark holds various United States and foreign patents related to purification of oils, chemical processes, and application of centrifugal machinery to industrial and process work. He is also the author of a number of articles on chemical processing.

E. B. Busenburg

E. B. Busenburg Retires

Earl B. Busenburg, manager, reclaim rubber laboratories for the B. F. Goodrich Co., Akron, O., has retired after a career of nearly 40 years in the rubber industry.

Busenburg joined the Philadelphia Rubber Works Co., in its Akron general laboratories in 1922, after studying chemistry at the University of Akron. He was named chief chemist in 1929. The company became part of B. F. Goodrich in 1931.

During World War II, Busenburg was loaned to the government to serve on the staff of technical consultants assisting William M. Jeffers, United States rubber director; he served in this capacity for more than two years.

Busenburg is a member of the Rubber Division of the American Chemical Society and, since 1950, has served as secretary-treasurer of the division's 25-Year-Club. He is a member of the Akron Rubber Group and was chairman of the group in 1945-46. For many years he has been active on the technical committee of the Rubber Reclaimers' Association.

NR Research Program

The Malayan natural rubber industry is doing considerable basic research into natural rubber, with the aim of producing an improved product at lower cost, Leslie Bateman, director of the Natural Rubber Producers Research Association, London, England, said during a visit to New York, N. Y., in May.

Dr. Bateman met with the rubber trade press while in New York as part of a tour to talk with rubber producers in the United States.

He pointed out that the situation of natural rubber was rather different from that of synthetic rubber as regards product research, control of product quality, and technical service. This is because there are many rubber producers from a number of countries. He added, however, that steps are being taken to formulate plans for a world producers group which could cooperate on research, set up quality standards, and so on.

Dr. Bateman also said that natural rubber producers have been behind makers of synthetics both in research and in technical service to help customers make best use of the product. However, he said, natural rubber researchers are doing some extremely interesting studies on just how the rubber tree produces its product, with the hope that eventually this production can be controlled both in quality and quantity.

B. F. Goodrich Footwear & Flooring Co., Watertown, Mass., received awards from the National Safety Council, the Massachusetts Safety Council, and the Associated Industries of Massachusetts for more than three million consecutive manhours without a disabling injury. Accepting the awards are Richard T. Wise *(left)*, superintendent, engineering and maintenance, and John C. MacKinnon *(center)*, general manager. The awards were presented by Charles L. O'Reilly, president of the Massachusetts Safety Council, and John Hamilton, director of public affairs for the Associated Industries of Massachusetts. William J. Dooling, supervisor, fire and safety, looks on

Giant railroad tank cars that hold twice as much as standard tank cars are now being used by the Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn., for latex shipments. The 53-foot-long cars hold 20,000 gallons of the rubber, which is used for impregnating paper, molding rubber products, and backing carpets

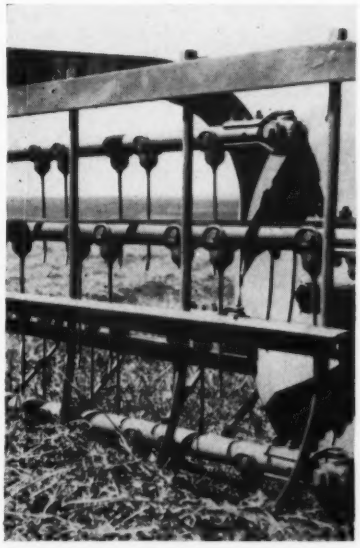
The Ohio Rubber Co., Willoughby, O., has started manufacturing operations at its recently completed 190,000-square-foot, $3,500,000 plant in Fort Smith, Ark. Expected to employ initially about 250 people, the company's fifth manufacturing facility will make molded precision rubber parts for oil field, automotive, and general industry, and semi-pneumatic tires for industrial and agricultural implement applications

Amerace Corp. Buys Swan Rubber Co.

A cash offer by Amerace Corp., New York, N. Y., to buy Swan Rubber Co., Bucyrus, O., was accepted by the board of directors of Swan and approved by Swan shareholders last month. The purchase price was $22,220,400.

Swan, a manufacturer of mechanical rubber goods, expects sales of approximately $22,700,000 and net profit of about $3,500,000 before federal income taxes for the fiscal year ending July 31. Present Amerace divisions had sales of $27,700,000 and net profit of $3,255,000 in the fiscal year which ended December 31, 1960.

A ball-joint socket of rubber which joins the metal tooth and the mounting bracket helps give this new type of hay rake tooth greater resistance to breakage than previous coil-type teeth, and it rebounds to normal raking position after passing over an obstruction. Made by Goodyear Tire & Rubber Co., Inc., Akron, O., for Deere & Co., Moline, Ill., the teeth are being used on five 1961 rake models



New Materials

(*Continued from page 22*)

Synpol 8209B is a cold SBR extended with 25 parts of naphthenic oil. This polymer, with a bound styrene content of 35%, contains a non-staining, non-discoloring stabilizer. It is recommended as an economical rubber which offers further savings when utilized in low-cost, highly loaded compounds such as that for neutral floor tile. Suggested applications include floor tile, shoe soling and heels, cable jacketing, battery boxes, steering wheels, household goods, bowling balls, and coated fabrics.

(*Continued from page 105*)

Rubber. Traditionally, URW has sought a general contract renewal, a two-year pact without any wage benefits, and then later "reopened" these basic contracts for subsequent wage negotiations. Also in the past, URW has sought across-the-board wage boosts rather than higher rates for given classes of workers.

In the newest contracts negotiated with the major companies, which are expected to set the pattern for settlements throughout the industry as a whole, URW did not insist on this, settling instead for lower wage benefits for less-automated workers in the companies' non-tire plants. (See RW for April Washington Report, page 92; May, page 100.)

As in the Firestone-U. S. arrangement, the agreement with Goodyear calls for a 7½¢-an-hour-wage increase in all Goodyear tire plants effective June 5. On the same date, a 3½¢ hourly increase becomes effective in all Goodyear's non-tire plants. The following year, starting June 11, 1962, an additional 7¢ hourly increase is provided for the company's tire plants, and a 4¢ hourly raise is slated for employes in non-tire plants. An estimated 20,000 hourly rate employes in 11 Goodyear plants are affected.

The URW agreement with General was slightly different. It provided only for the two increases of 7½ and 7¢ between now and 1962 for tire workers in General's Akron and Waco, Tex., plants.

Meetings and Reports

(*Continued from page 103*)

meeting were the attendance, as special guests, of the graduates of the Chicago Rubber Group 1960-61 Course in Rubber Technology and the election of new officers.

Officers elected were: Theodore C. Argue, president, Roth Rubber Co.; Robert Kann, vice president, Goodyear chemical division; Harold Stark, secretary, Dryden Rubber Division; Stanley Shaw, treasurer, Witco Chemical Co.

Elected to the board of directors were: (manufacturers) Fred Klepetar, Johns Manville Corp., and Cornelius Woods, Dryden Rubber; and (suppliers) Joe E. Stonis, C. P. Hall Co. of Illinois, and Charles F. Wimmer, Phillips Chemical Co.

Frank Taylor, Signal Oil & Gas Co., past Group president and long-time member of the Group, was awarded a life membership in it.

news briefs

E. I. DU PONT DE NEMOURS & CO., INC., elastomer laboratory, at Chestnut Run, Pa., has achieved a safety record of 32 years without a time-losing injury on the job. This is the longest injury-free time span recorded by any unit of the company.

JOHN A. ROEBLING'S SONS, The Colorado Fuel & Iron Corp., Trenton, N. J., will move its New York and Philadelphia offices to a new office and warehouse at Adams Station, N. J.

LEE RUBBER & TIRE CORP., Conshohocken, Pa., has opened two factory branches in the greater Pacific territory, which will be located at 1407 S. E. Belmont, Portland, Oreg., and 2901 First Ave., So., Seattle, Wash.

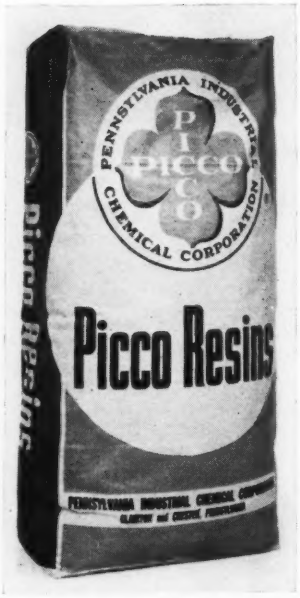
FIRESTONE PLASTICS CO., Exon vinyl resin plant, Pottstown, Pa., has expanded its production facilities to include the enlargement of the reactor building, installation of 12 additional reactors, and construction of a new sub-station, pump house, and cooling tower.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., has named Adams & Westlake Co., Elkhart, Ind., a fabricator and distributor for Armaplate, a rubber-covered steel sheet, which Goodyear markets.

GENERAL FOAM CORP., Hazleton, Pa., is expanding its facilities for the manufacture and processing of urethane foam by leasing a 68,000-square-foot building across the street from its existing plants.

UNITED CARBON CO., INC., has moved its Pacific Coast district sales office from 3932 Wilshire Blvd., Los Angeles, to 630 W. Duarte Rd., Arcadia, both in Calif.

PARKER SEAL CO., a division of Parker-Hannifin, Culver City, Calif., has appointed Cal-State Seal Co., Garden Grove, Calif., and Seals & Engineering, Inc., Rockford, Ill., distributors. Cal-State Seal will cover Orange, Riverside, and San Bernardino counties in Southern California, and Seals & Engineering will cover Rockford and the surrounding area.



Pennsylvania Industrial Chemical Corp., Clairton, Pa., has introduced a new bi-color package for synthetic resins in the flaked form. Designed by the multi-wall bag division of St. Regis Paper Co., the bags are three-ply 150-weight "duo-stress" (extensible) bags. They will be printed in red and black, bearing the cloverleaf insignia of Picco products

MOBAY CHEMICAL CO., Pittsburgh, Pa., has expanded its plant facilities raising production capacity for tolylene diisocyanate (TDI) from 25 to 40 million pounds. Also, plans were approved to begin construction of an additional 10-million-pound facility at a cost of $1.5 million.

ANSUL CHEMICAL CO., Marinette, Wis., and CONTINENTAL OIL CO., Houston, Tex., plan to construct and own jointly a petrochemical plant at the Lake Charles, La., which will produce annually some 60 million pounds of methyl chloride. Cost of the facility is estimated at more than $1 million.

SCOTT TESTERS (SOUTHERN), INC., Spartanburg, S. C., recently completed new plant facilities which will double the operating capacity of the company's five-year-old building. The firm is a subsidiary of Scott Testers, Inc., Providence, R. I.

J. M. HUBER CORP., New York, N. Y., has acquired the assets of International Clay Co., Graniteville, S. C. International Clay's mine and properties adjoin Huber's largest mine in South Carolina.

NAUGATUCK CHEMICAL DIVISION, United States Rubber Co., has transferred its vinyl plastic compounding operation from the Division's main plant in Naugatuck, Conn., to newly erected facilities at its vinyl resin plant in Painesville, O.

GOODYEAR INTERNATIONAL CORP., Akron, O., has reached an agreement with Dunlop Rhodesia, Ltd., for the manufacture of Goodyear passenger and truck tires under license in Dunlop's factory at Bulawayo, Southern Rhodesia. Goodyear will distribute the tires throughout the Central African Federation composed of Northern and Southern Rhodesia and Nyasaland. Production is expected to begin this fall.

T A B ENGINEERS, INC., has moved from 767 N. Milwaukee Ave., Chicago, Ill., to 520 N. Michigan Ave.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., has been awarded a quarter-million-dollar contract to produce specially designed tires for B-58 supersonic bombers. The tires will be delivered to the Convair Division, General Dynamics Corp., Fort Worth, Tex.

MINING & MINERAL PRODUCTS DIVISION, Dicalite department, Great Lakes Carbon Corp., Los Angeles Calif., has been appointed exclusive sales representative for Solka-Floc, a cellulose filtering agent manufactured by the Pulp & Floc Division of Brown Co., Berlin, N. H.

news about people

John E. Hobbs has been made vice president of General Latex & Chemical Corp., Charlotte, N. C. He will also continue as general manager.

Frank T. Tucker, director of advertising, The B. F. Goodrich Co., Akron, O., retired May 1, after more than 41 years of service.

Louis J. Croce becomes manager of the Petro-Tex research department, Food Machinery & Chemical Corp., Chemical Research & Development Center, Princeton, N. J.

Henry R. Hutt is now southern regional sales manager for International Latex Corp., chemical division, Atlanta, Ga.

Jack R. Monte becomes vice president of O'Sullivan Rubber Sales, Inc., Winchester, Va.

Dean Forrest has been appointed to the newly created position of plant engineer of The General Tire & Rubber Co., Mogadore chemical plant, Mogadore, O.

Harry D. Glenn has been named factory manager of the two Baton Rouge, La., plants of Naugatuck Chemical Division, United States Rubber Co. He replaces **J. Scott Brown,** now operations manager for Naugatuck Chemical International.

John M. Hogg is the new plant manager of Sid Richardson Carbon Co., Fort Worth, Tex. **Grant C. Boardman** will serve as assistant plant manager.

Russell G. DeMaat is now manager of Superweld Corp., machinery and equipment division, North Hollywood, Calif.

Richard J. Hearty, since 1953 executive vice president of Imperial Electric Co., Akron, O., has been elected president, succeeding his father, **John Hearty,** who was president of the company from 1904 until his recent death.

R. E. Mulcahy

T. H. Tollner

H. R. Hutt

H. Shannon

J. M. Hogg

J. W. Berg

G. C. Boardman

C. R. Simpson

Thomas H. Tollner has been named regional sales manager for the new fiber marketing sales office of Allied Chemical Corp., at Akron, O. **Harry A. Greene,** a sales representative of the New York regional sales office of fiber marketing, will transfer to the Akron office. **Othello Scarponi** will be responsible for evaluating Caprolan® nylon tire yarn; and **Robert E. Mulcahy,** formerly New York regional sales manager for fiber marketing, becomes manager of marketing, industrial.

Howard Shannon has been elected vice president of Amerace Corp., New York, N. Y. Associated with four Amerace divisions, Shannon is president of American Hard Rubber Co. and Supplex Co. and also supervises Ace Bowling Co. and Ace Comb Co. operations.

J. N. Kuzmick becomes vice president and a director of Manhattan Rubber Mfg. Co., Neenah, Wis., a wholly owned subsidiary of Raybestos-Manhattan, Inc., Passaic, N. J. **R. B. Hazard** is now a director. **A. A. Campbell,** formerly resident manager, has been made vice president; and **A F. Kuehn, Jr.,** becomes resident manager.

Cyril S. Kimball has been elected president of Foster D. Snell, Inc., New York, N. Y. Kimball served as executive vice president of the corporation since 1953.

John W. Berg is now manager of the Trenton, N. J., office of Harwick Standard Chemical Co. **C. R. Simpson,** recently transferred to Trenton from the firm's home office in Akron, O., will assist him.

W. Gerald Wilson, who joined The B. F. Goodrich Co., Akron, O., a year ago as senior analyst of international affairs, has been named manager of market planning for the company's international division.

Robert W. Klatt has been appointed vice president in charge of sales for American Chemet Corp., Chicago, Ill.

news about people

William C. Capehart has joined the Dewey & Almy Chemical Division, W. R. Grace & Co., Cambridge, Mass., as field sales representative for the organic chemicals division.

Stanley E. Moore and **Robert O. Smith** have become sales representatives of the New Jersey Zinc Co., pigment division, New York, N. Y. Moore has been assigned to the Kansas, Missouri, Arkansas, Kentucky, and southern Illinois territories. Smith will be active in the Chicago area and Minnesota.

Edward L. Carr has been appointed manager of research and development for Firestone Synthetic Rubber & Latex Co., Akron, O.

Kenneth H. Pettengill becomes manager, process research section, Emery Industries, Inc., organic chemicals division, Cincinnati, O. **Herbert M. Kay** is now a product development representative, development-service department.

James Case has joined the sales and service staff of Conforming Matrix Corp., Toledo, O.

Paul W. Libby has been named technical service manager of the industrial products department of J. M. Huber Corp., Borger, Tex.

Lincoln L. Redshaw is now president of the U B S Chemical Co., Cambridge, Mass., division of A. E. Staley Mfg. Co., Decatur, Ill. He succeeds **Paul W. Atwood,** who retired May 5, but who will continue his association with U B S and Staley on a consulting basis.

George A. Mentzer is now advertising manager of commercial products for The B. F. Goodrich Co., Akron, O. He succeeds **George B. Koch,** recently named merchandising manager for B. F. Goodrich Industrial Products Co.

Joel R. Nelson becomes chief chemist of Major Chemical & Latex Corp., Boston, Mass.

Robert B. Waters has been made technical sales representative in the greater Chicago area for the Schenectady Varnish Co., Schenectady, N. Y.

J. R. Powell has been appointed New England sales representative for Landers-Segal Color Co. His office will be at 28 Raymond Ave., Beverly, Mass.

W. C. Capehart

J. Wright

E. L. Carr

R. B. Kron

P. W. Libby

J. N. Street

D. C. Maddy has become executive vice president of Harwick Standard Chemical Co. of California, Los Angeles, Calif. Maddy has been with Harwick Standard since 1946 and was manager of its Los Angeles office until the incorporation of the California company in July, 1952, when he was elected vice president.

Harold C. Lilholt, market analyst, store administration department, B. F. Goodrich Tire Co., has been named operating manager of International B. F. Goodrich Co., Akron, O.

Donald F. Hutchinson is now a chemist for the Vicksburg, Miss., plant of U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.

Jack Wright has been named southwestern sales representative for Falls Engineering & Machine Co., Cuyahoga Falls, O. He will cover Mississippi, Louisiana, Arkansas, Oklahoma, Texas, and Tennessee west of the Tennessee River.

Hermann Rogge has been elected president of Kenrich Petrochemicals, Inc., New York, N. Y., and **Oscar A. Spiegelhalder** becomes head of Kenrich International, the company's international sales division. Spiegelhalder will head the board of directors' executive committee on which he will serve with Rogge and the board's chairman, **Martin Wright.**

Richard B. Kron has been appointed eastern regional sales manager of Morton Chemical Co., Chicago, Ill. He will supervise the company's sales force in 14 eastern states.

Alfred G. Cavicchioli has joined the silicones division, Union Carbide Corp., as a technical representative of the rubber service group, Tonawanda, N.Y.

John N. Street is now vice president in charge of research of Firestone Tire & Rubber Co., Akron, O.

John R. Hodson has been appointed to the newly created position of manager of sales services of Texas Butadiene & Chemical Corp., New York, N. Y. **B. D. Berkman** has joined the company as sales development engineer in the polychemicals department.

Irving Zamcheck and his associates join the New England sales office of the Bearfoot Sole Co., Inc., Boston, Mass. The organization will cover Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and central-western New York State.

William Swan is now western sales manager of Parker Seal Co., a division of Parker-Hannifin Corp., Culver City, Calif.

J. K. Jamieson has been elected a vice president and member of the board of directors of Humble Oil & Refining Co., Houston, Tex.

Robert Burge has been named district manager for B. F. Goodrich Industrial Products Co. at Columbus, O. His area includes southern Ohio, Kentucky, and most of West Virginia and Indiana.

E. David Gordon is now vice president and general manager of the Sperry Rubber & Plastics Co., Brookville, Ind.

(*Continued on page 122*)

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AZODOX high apparent density zinc oxides

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- Less Bag Breakage
- Close-Packed, Unitized Shipments

AZODOX stores in much less space than other zinc oxides. That's because you get many more pounds of AZODOX per cubic foot of pigment—up to 62 lbs. per cubic foot! Save valuable space for other purposes with every ton of AZODOX you buy.

In the manufacture of AZODOX, an exclusive process removes excess, space-wasting air from between individual particles of zinc oxide. Actual pigment density and every other desirable property remain unchanged. High apparent density AZODOX flows freely yet dusts less, incorporates fast and disperses thoroughly.

AZODOX is available in the following grades at no additional cost over conventional zinc oxides:

	Bulk Density lbs./cu. ft.	Rate of Activation	Reinforcement Properties
AZODOX-44 (Conventional)	60	Medium	High
AZODOX-55 (Conventional)	60	Fast	High
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AZODOX-550 (Conventional)	58	Medium	High

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news from abroad

Europe's Most Mechanized Tire Plant To Open Shortly at Dneipropetrovsk

What is probably Europe's most mechanized tire plant, designed by British engineers and utilizing British machinery, will open shortly near Dneipropetrovsk, near the Dneiper in Russia, according to an article in the April 15 issue of *Rubber and Plastics Weekly*.

The factory, designed to produce two million tires a year ranging in size from small-car tires to tractor and earthmover types, has a total floor area of 765,000 square feet. A separate building with a floor area of 326,000 square feet will store raw materials and finished tires, and separate buildings will house tire test equipment, machine shop and water, compressed air, and electrical switching equipment.

Fabric rolls, each weighing half a ton, are conveyed to the fabric lines at the rate of 12 an hour by a semi-automatic overhead runway. The rolls are attached by slings to electric lift hoists at a loading station, and by a preselector switch the operator is able to direct the hoist to any one of three unloading stations in the manufacturing building. To insure regular spacing of the units, the electrical supply busbars are broken for a section between each station, insuring that there is no power to a section when the station in front is occupied.

Rubber is brought into the manufacturing building by an overhead conveyor system with a rate of flow of 10 tons an hour. Bales are conveyed in basket-type carriers, dispatched by push-button selection to one of four unloading stations. It is possible to program so that a specified number of bales is sent to an unloading station before work is done on any of them. Bales are pushed clear of the carrier by air-operated rams.

At two bale-cutting machine stations, air-operated turnover frames turn the bales ready for cutting, and at two pelletizing machine stations auxiliary belt and powered roller conveyors take the bales to the machine hopper.

After fabrics have been treated and passed through calenders for rubber topping, they are conveyed from the two fabric lines to any one of eight storage racks by a semi-automatic overhead runway, with operators controlling destination by push-button control. The rolls are removed from the storage racks and delivered to six bias cutting machines by a semi-automatic runway incorporating four double hoisting units. After passing through the bias cutting machines, the material is batched in smaller rolls and stored in 60 powered vertical racks, one for each type of ply material. Each rack consists of two endless lengths of heavy-duty bushed roller chain fitted with special attachments to receive the fabric roll box ends. When a roll is fitted, a sprocket revolves, elevating the chain and bringing the next vacant attachment into position.

When the rolls are brought out of storage to the tire building area by conveyor, they are circulated around the area by one of two conveyors, depending on whether they are for single-ply machines or band-building machines. When a service operator requires a roll of material, he uses a selector switch and push-buttons which activate a unit on the conveyor. The next carrier with the required material is automatically directed on to the machine loop from which the call was made. When the operator takes off the unit, he puts an empty liner on to the conveyor, which takes it back for removal and reuse.

Treads are brought to the tire building machines by an overhead belt-conveyor system incorporating vertical hugger belts. One conveyor feeds each of the four lines of tire building machines. Above each machine a short length of hinged roller conveyor is arranged, feeding into the vertical hugger belts leading down to the machine table. On signal, the roller section will lower and feed the tread on the conveyor down to the machine table.

Green tires are removed by an overhead monorail conveyor with saddle carriers loaded by hand. For larger types a semi-automatic runway system incorporating six hoists is used. When an operator is ready to load a tire, he pushes a button which causes the next hoist to stop at his machine.

Two overhead monorail conveyors deliver truck and car tires to 40- and 55-inch curing presses, and a hoist conveyor handles the heavy-duty tires destined for the 75-inch presses. The conveyors travel between two rows of presses set up back to back, feeding the green tires to the feeder conveyors set up with each pair of presses. The feeder conveyors are electrically interlocked with the curing presses and automatically feed pairs of tires into the presses during the automatic press cycle.

The larger tires are suspended by specially designed grabs and taken to a storage bank, where tires are automatically conveyed to the 75-inch presses as needed. Cured tires are discharged automatically from the back of the presses on to belt conveyors and delivered to the finishing department. From there tires are taken by overhead conveyor to the plant storage area.

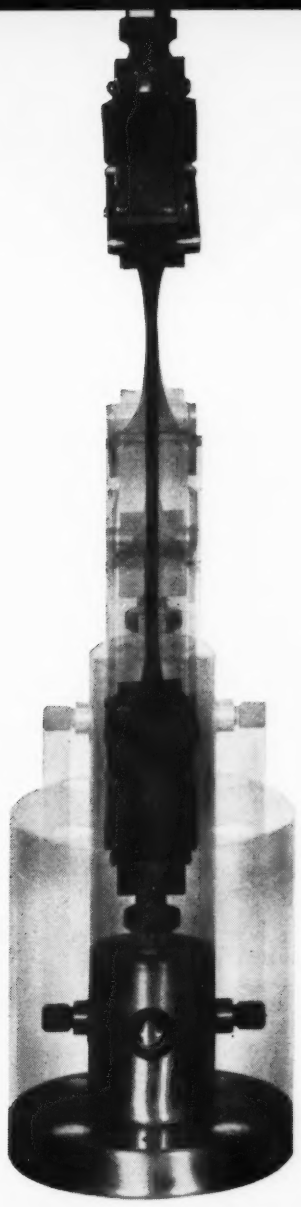
Dunlop Will Construct Malayan Tire Factory

Dunlop Rubber Co., Ltd., has reached an agreement with the Malayan Government to build a factory to produce a wide variety of tires for motor vehicles and bicycles. The factory, to be built in Petaling Jaya, is scheduled for completion late in 1962. It will employ about 600 persons when in full production.

Of the proposed capitalization of $12 million (Straits) in common stock, 39% will be offered to the public initially, and another 10% will be set aside for Malayan participation in line with Federation Government policy of encouraging Malays to enter commerce and industry. It was indicated also that Malayans would be trained to enable them to take supervisory and managerial positions.

Production is expected to cover anticipated Malayan consumption with a surplus for export.

Dunlop owns rubber plantations totaling 75,000 acres and employing 22,000 workers. A Dunlopillo factory employing about 200 persons supplies foam rubber cushions and mattresses for the local market and exports to nearby countries.



Rubber has more stretch when it's formulated with Neville C-I® Resin

Test after test on the Instron has clearly shown the superiority of quality rubber formulations using Neville Coumarone-Indene Resins in place of competing products. Compounds with Neville C-I Resin repeatedly showed better elongation and tensile strength characteristics both before and after aging.

But stretch and strength are not the only advantages gained through the use of these resins. Their unique ability to impart plasticity brings many processing benefits. Mixing, milling, calendering and tubing will be faster and smoother, and cures will be more uniform. You'll obtain improved mold flow, better knitting and a thinner flash line. Also, these resins are economically priced and will effectively lower pound volume cost in highly loaded stocks while still retaining good physicals. They are available in flaked, solid or liquid form and in a wide range of colors from ½ to 16 Neville. Softening points are from 10°C. to 155°C. Write for further information.

Neville Chemical Company, Pittsburgh 25, Pa.

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Resins—Coumarone-Indene, Hydrocarbon (Thermoplastic and Heat Reactive), Hydroxy • **Oils**—Plasticizing, Neutral, Rubber Reclaiming, Shingle Stain • **Solvents**—Aromatic (Refined and Crude), Semi-Aromatic (Refined and Crude). • **Antioxidants**—Non Staining Rubber • **High Purity Indene • Indene Derivatives • Crude Naphthalene.**

Rubber Tax Opposed

Sir John Hay protested what he termed discriminatory taxation by the Malayan Government when he addressed stockholders of Labu Cheviot Rubber, Ltd., in May at the company's general meeting. Sir John particularly opposed raising rubber export duties to provide funds for long-term projects, noting that for every pound paid to stockholders, more than two pounds of the company's funds went for taxes.

He argued that in the long run the economy must suffer from taxation, since no new agricultural development would be regarded as worthwhile if subject to such heavy taxation as now exists. He said that he recognizes the government's difficulties, but argued that other forms of agriculture and industry are not subject to such heavy rates, while new industry is temporarily exempt from all taxes.

Under present conditions, he said, continuance of "discriminatory and inequitable" taxation must seriously impair the natural rubber producer's ability to compete with the producer of synthetic rubber.

The Straits Times, commenting editorially on Sir John's statement, warned that the assumption that the cost of synthetic rubber cannot be materially reduced may be dangerous, nor should further surprises in the field of stereo rubbers be ruled out.

It said, "In the near future the economics of the rubber industry will be vastly changed, the price set not by the old fashioned demand and supply, but by the cost of an alternative rubber. What effect this will have on taxation, and especially the export duty, it is impossible to say, except that it is likely to be considerable."

It also noted that the difficulty of providing for replanting on an adequate scale is great and added that labor costs are a further problem.

Goodrich Iranian Plant in Production

Production has begun in a $7-million tire plant erected near Teheran, Iran, by B. F. Goodrich Iran, S. A., a subsidiary of The B. F. Goodrich Co., Akron, O. The 130,000-square-foot factory, which will manufacture tires, tubes, and tread rubber for passenger cars and trucks, is on a 40-acre tract adjoining the main line of the Iranian National Railroad which runs to Khorramshahr on the Persian Gulf.

The Iranian facility, which will employ 350 people when in full production, is the third tire plant to be built and put into operation by Goodrich foreign subsidiaries in 13 months. Last March, production of tires was started by B. F. Goodrich Australia, Pty. Ltd., near Melbourne, and B. F. Goodrich do Brazil, near Campinas. The company is also building a multi-million-dollar tire plant near Fort Wayne, Ind., with production scheduled late this year, and earlier this month broke ground in Kitchener, Ont., Canada, for a major tire plant.

Latex Production

Production of concentrated latex in Malaya came to 113,651 tons, dry weight, in 1960, including 2,497 tons cream concentrate, 104,493 tons centrifuged concentrate, and 6,661 tons concentrated by other methods, including Revertex and electro-decanted latex.

According to the *Planters' Bulletin* for March, 1961, 3,356.6 tons, (dry weight) of boric acid latex were shipped from Malaya in 1960, some 600 tons less than in 1959. Seven Malayan producers now are making this type of latex, and Liberia is said to have shipped sizable amounts to the United States. Great Britain took 40.4% of the 1960 shipments, and Continental Europe 55.3%. Japan and South Africa have also been buying boric acid latex. Licenses to produce this type of latex according to patents held by the Rubber Research Institute of Malaya are obtainable free of charge on application.

Exports for the first quarter of 1961 were 280,366 tons, compared with 282,609 tons in the same quarter of 1960. Practically all countries except the United Kingdom and Russia reduced their shipments during the 1961 quarter.

Malayan production of rubber in the first quarter of 1961 totaled 176,843 tons, available figures show. Estates contributed 102,348 tons, and smallholders 74,495 tons.

Clonal Seedlings Decline In Use

A drift away from the use of clonal seedlings on both European and Asian estates is revealed in an analysis by the *Planters' Bulletin* (March, 1961) of official figures on planting materials used in Malaya in 1959.

Whereas European and Asian owners had used clonal seedlings for, respectively, 39 and 46.2% of the acreages they planted in 1954, the corresponding proportions for 1959 plantings fell to 18.2 and 28.7%, respectively. The combined area of clonal seedlings planted on the two categories of estates came to 22,857 acres in 1958 and 18,015 acres in 1959. Buddings were used on 66,025 acres in 1958 and on 60,232 acres in 1959.

The older clones have been losing favor with European producers, but Tjir. I, one of the oldest, continues to be by far the most popular clone on Asian estates, and in 1959 there was a further increase in acreage planted to this clone.

Among the newer clones becoming increasingly popular on European estates, are GT 1, imported from Indonesia, where it is one of the highest yielding clones and is planted on a large scale; also clones of the RRIM series and new Chemara and Prang Besar clones.

Some of the RRIM 600 clones have been performing very satisfactorily in large-scale trials at the RRI experiment station. RRIM 600, the leading clone of the 600-618 series, gave 2,523 pounds per acre in its fifth tapping year and averaged 1,552 pounds per annum over the five years. Other clones of this series gave 1,877, 1,660, and 1,610 pounds per annum, respectively, in their fifth tapping year. A few clones of the RRIM 619-630 series, in their fourth tapping year in similar trials, appear to be even more spectacular performers. Thus 628, gave 2,381 pounds per acre in the fourth tapping year and averaged 1,849 pounds per acre per annum over four tapping years, while the corresponding figures for 623 were 1,895 and 1,641, respectively.

All the RRIM clones mentioned above have been recommended for experimental planting by estates, one also for planting on a moderate scale. It now remains to be seen how they continue to perform and especially how they react to different estate conditions over a period of years.

Gamma Vulcanizing

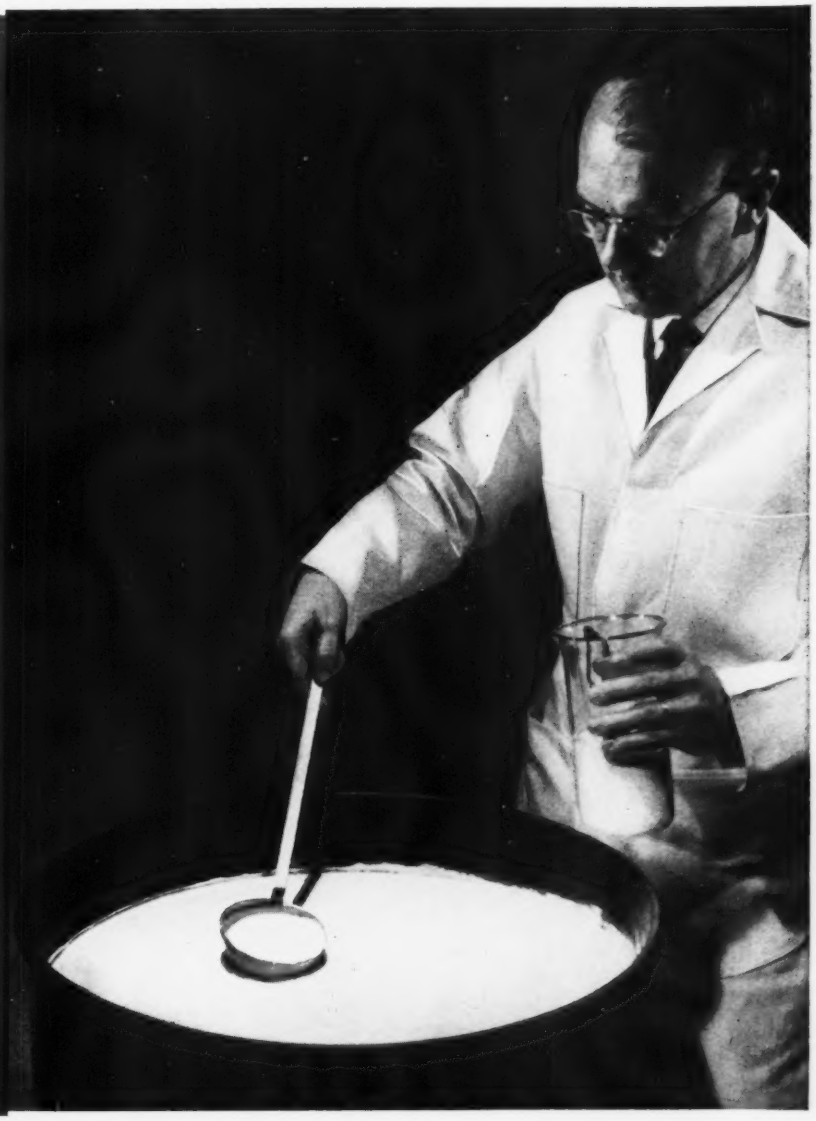
The efficiency of various sources of gamma radiations for vulcanizing tubeless tires was examined by A. Kh. Broger and others.[1] The radiation sources were of two types: a circulation loop, in which the carrier of gamma radiation is an indene-gallium alloy (16.5 atomic % indene) and spent fuel elements from a VVR-Ts nuclear reactor with a thermal capacity. Judged by their relative efficiency in utilizing gamma radiation, the circulation loop was best (approximately 2%); but its use involves greater technical difficulties than the fuel elements. When the latter are used, best results are obtained with the irradiator in two parallel planes—η is approximately 0.3% against 0.2% for the co-axial cylinder type.

The irradiators based on circulation loops were of three forms—(1) a ring located inside the tire; (2) two pairs of concentric rings on either side of the mold; and (3) a loop bent around the mold in a sector; the mold is rotated to achieve uniform dosage at all points in the tire. The fuel elements were in the form of (a) two co-axial cylinders and (b) two parallel planes.

[1] *Soviet Rubber Tech.*, Sept., 1960, p. 16.

What's News in Rubber...

NOW... BUTYL RUBBER IN LATEX FORM



Now you can get Butyl Rubber in convenient latex form – an easy-to-handle emulsion that has all the outstanding properties of Butyl!

Enjay Butyl can now be utilized in tire cord dipping, paper coating and saturating, textile treating and proofing, roof coating, adhesive compounding, emulsion paint formulations, and leather finishing.

Enjay Butyl Latex is shipped FOB Baton Rouge, La. in phenolic-lined, insulated 8,000 and 10,000-gallon tank cars, or in lined 55-gallon open-head steel drums. Drum stocks will be warehoused at other strategic shipping points in accordance with demand.

For more information and your copy of our Latex manual, write to Enjay at 15 West 51st Street, New York 19, New York.

TYPICAL INSPECTION DATA	
Total Solids, wt %	55
Specific Gravity, 70°F	0.96
pH	5.0
Viscosity, cps	560
Mechanical Stability	Excellent
Freeze-Thaw Stability	Excellent
Chemical Stability	Excellent

ENJAY BUTYL

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

news from abroad

Iron Curtain Plants

Reports indicate that production of synthetic rubber is rapidly growing in the Iron Curtain countries. Rumania is building a synthetic rubber plant with an annual capacity of 50,000 tons, and production of synthetic rubber in Poland rose from 4,950 tons in 1959 to 19,839 tons in 1960, according to government announcements. In 1959, Poland imported 69,809 tons of natural and synthetic rubber.

Meanwhile Czechoslovakia is planning synthetic rubber plants which it expects will give it, when completed, a total output greater than that of West Germany. Along with the rubber plants it is planning a chemical complex for coal tar products which it expects to be the biggest in Europe. Also planned is concentration into huge "Kombinats" or combines to achieve as much automation and productivity as possible in oil processing and production of chemicals, rubber, and paper.

Light Aging Tester

Tests at the Institut Français du Caoutchouc[1] indicate that the best apparatus at present available for studying accelerated aging of natural rubber in light is the Xenotest W. L. made by Quarzlampen Gesellschaft.

The arc lamp used in the ASTM method gives spectrum lines rather different from the solar spectrum, and results do not always agree with those of natural aging, it is pointed out; while the Xenon lamp gives a continuous spectrum close to the solar spectrum, especially toward the wave lengths in the blue to violet range, which include those most harmful to rubber.

The light source of the Xenotest is a Xenon tube in which the ultra-violet section of radiation is corrected by a system of filters to bring it as close to that of the sun as possible; the infrared section is filtered to prevent overheating. The apparatus is in the form of a column, and samples are mounted on supports integral with a rotating unit designed to move so as to expose the samples to radiation during half the operation time. The unit is enclosed in a chamber into which water can be sprayed at regular intervals to maintain a definite humidity.

Comparative tests with the Xenon lamp and natural aging were conducted on 13 different colored compounds of smoked sheet, colors ranging from white through shades of ivory, beige, ochre yellow, to dark ochre brown. For each compound were determined: change in color, time when first cracks appear, density of cracks, and loss in mechanical properties. One set of samples was exposed to the Xenotest for 25, 50, 90, and 140 hours, and the other to natural aging for 10, 20, 30, 50, and 60 days. With few exceptions, results with the Xenotest corresponded well with those of natural aging tests. It is noted, however, that under the conditions in which it was used, the device does not show up the phenomenon of "blushing" (turning pink).

[1] *Rev. gén. caoutchouc*, Feb., 1961, p. 225.

Synthetic Rubber Use Growing in Germany

Synthetic rubber consumption in Germany this year is expected to be equal to, if not higher than, that of natural rubber, the April issue of *Kautschuk und Gummi* predicts.

The magazine notes that the percentages of natural rubber in total rubber industry use dropped from 76% in 1950 together with 3% synthetic rubber, 20% reclaim, and 1% plastics, to 65% in 1955. Meanwhile, percentage of synthetic rubber was up to 12% and plastics up to 3%, with reclaim remaining at 20%.

Last year natural rubber accounted for only 41% of total consumption; synthetic rubber, 32%; plastics, 9%; and reclaim, 18%. The actual figures were: natural rubber, 121,655 tons; synthetic rubber, 96,717 tons; plastics, 26,036 tons; and reclaim, 55,170 tons.

Also noted is an increase of almost 400% in production of motor cycle and automobile tires, and nearly 200% in commercial-vehicle tires, over the decade from 1950 to 1960. There were also sharp increases in production of tire repair materials, heels and soles, conveyor belts, lined hose, soft rubber mechanical goods, and hard rubber goods, but drops in production of bicycle tires and rubber footwear. The decline in output of bicycle tires followed the increase in motorization, but footwear drops were due to imports of cheap footwear. For example, imports of rubber-soled sports shoes amounted to 60% of production in the first 10 months of 1960.

The table shows figures for 1950 and 1960.

	1950	1960
Cycle tires .... *tons* ..	19,502	14,985
Motorcycle and car tires	26,316	103,264
Commercial-vehicle tires	44,151	110,406
Tire repair material ...	7,829	29,667
Total tires	97,798	258,322
Heels and soles	22,279	45,501
Rubber footwear	10,912	11,891
Conveyor belts	6,139	12,643
Lined hose	7,461	16,975
Other soft rubber mechanical goods ...	30,580	101,142
Druggists sundries ...	4,627	30,054
Rubberized fabrics and manufactures	4,118	5,242
Other soft rubber goods	11,969	37,860
Hard rubber goods	5,233	16,192
Total other goods .	103,318	277,500
Grand Total	201,116	535,822

Rubber Thread Measure

A photoelectric method for measuring the diameter of rubber thread, used at the Red Rubber Worker factory, is described by A. N. Faidysh and others in *Soviet Rubber Technology* (Oct., 1960, p. 47), using a FEID-1 photoelectric device. The instrument is equipped with a differential silver sulfide FESSO-10 photocell consisting of two independent halves, and a thread carrier designed to insure exact positioning of the thread without strain or sag. Inside the carrier is a groove along which the thread is drawn by hand and also an attachment for turning the thread to permit checking its oval shape as well as its maximum and minimum diameters. Measurements are determined with the aid of a microammeter built into the amplifier panel through which current from the photocell passes.

Better Silicone Cures

The introduction of vinyl groups into polysiloxane rubber increases its vulcanization activity, permitting vulcanization with reduced amounts of benzoyl peroxide, or with other less active peroxides, as well as with sulfur and its compounds, according to I. K. Stavitskii and V. M. Svetozarova.[1] Compared with polydimethylsiloxane vulcanizates, those of vinylsiloxane rubber containing a small number of vinyl groups have greater heat stability at 250° C. and reduced compression set.

[1] *Soviet Rubber Tech.*, Oct., 1960, p. 8.

MnO_2 Vulcanization

Rate of cure and tensile strength of vulcanizates increase with increasing fineness. This was the conclusion of tests to determine the fineness of manganese dioxide on rate of vulcanization of liquid Thiokol and on the mechanical properties of the vulcanizates, which were conducted by M. G. Beregovskaya and others.[1]

Random portions of a single batch of MnO_2 were separately sieved, and MnO_2 content of the resulting fractions determined. Fineness was determined by sedimentation, microscopic examinations, and by catalytic decomposition of hydrogen peroxide; the last proved to be the most convenient and reliable method.

The tests also showed that within limits defined by the variations in initial MnO_2, variations in the MnO_2 content

[1] *Soviet Rubber Tech.*, Sept., 1960, p. 34.

TOP QUALITY BECOMES ECONOMY AS KVP RELEASING PAPER IS USED AND RE-USED

KVP® Releasing Paper is in constant use at the Goodyear Tire and Rubber Company's plant in St. Mary's, Ohio. It is ideally suited to the handling of the highly-adhesive rubber products manufactured in this plant.

Below we see one of the steps in the production of diaphragms for industrial use. Layers of rubber are cemented together and assembled on trays covered with sheets of KVP Releasing Paper. Though extremely sticky on all surfaces, the rubber parts never cling to the releasing paper, even when weight-pressure mounts as the trays are stacked high. Nor does the paper shred, defibre or lint on to the rubber.

Yet, the high quality of KVP Releasing Paper becomes an *economy* for Goodyear because of its re-use factor. Not until the heat-treating stage is the KVP Releasing Paper discarded—then *only* because it becomes impractical to reclaim.

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...the paper people

KVP SUTHERLAND PAPER COMPANY... Kalamazoo, Michigan

of pastes have no effect on the mechanical properties of liquid Thiokol. Pastes containing the coarsest particles, although richest in MnO_2, give the slowest rates of cure and the lowest tensile strength. It is noted that the control paste, sieved in accordance with departmental specifications through a No. 60 sieve, gives weaker vulcanizates than a paste containing the finest MnO_2. Apparently sieving through a No. 60 sieve does not insure that a uniform and sufficiently fine material is obtained to give vulcanizates of liquid Thiokol with optimum mechanical properties.

■

PELLETIZED NEWS

The first unit of the Progil-Bayer-Ugine factory at Pont-de-Claix, near Grenoble, France, recently went on stream to produce isocyanates, polyethers for production of urethane rubbers and foams. The factory, jointly established by Progil S.A. and Ugine, both of Paris, will go into full production by the end of the summer.

A machine for continuously forming and vulcanizing foam rubber in any length has been designed by the Netherlands firm, N. V. Euromatic, Europese Maatschappij voor Mechanisatie, Weesp. The machine is claimed to be fully automatic and to reduce loss of base material to a minimum.

CHEAH THEAM SWEE, Assistant Minister of Commerce and Industry for Malaya, has asked the Federation House of Representatives to approve a $44 million (Straits) replanting plan which would include $23 million (Straits) for estate replanting, $10 million (Straits) for smallholder replanting, $9.5 million (Straits) for new planting, and $1.5 million (Straits) for improving the supply of planting material. The government also wants a raise in the replanting grant for holders of less than five acres as part of added inducements to push replanting and to enable the fund to control replanted holdings for a longer period to prevent premature tapping.

news about people

(Continued from page 114)

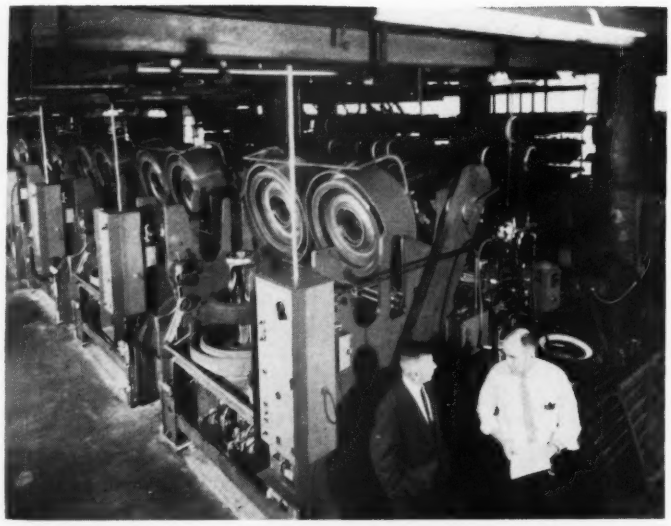
C. A. Failing, managing director of Goodyear-Indonesia, was named managing director of Goodyear-South Africa, Goodyear International Corp., Akron, O., succeeding **C. L. James,** recently appointed general sales manager of Goodyear International. **C. A. Kersten,** sales manager of Goodyear-Indonesia, becomes managing director, succeeding Failing; while **Sjafiri Alim,** sales supervisor, is now sales manager responsible to Kersten. **A. W. Dunn,** sales director for the Philippines, was appointed vice president and general manager, succeeding **R. W. Pockmire,** recently made regional director for the Far East and Australasia; and **B. A. Nelson,** manager of original-equipment sales and the auto tire department, Philippines, was named sales manager to succeed Dunn.

William E. Wolstenholme has been appointed a senior research scientist at the research center of United States Rubber Co., Wayne, N. J.

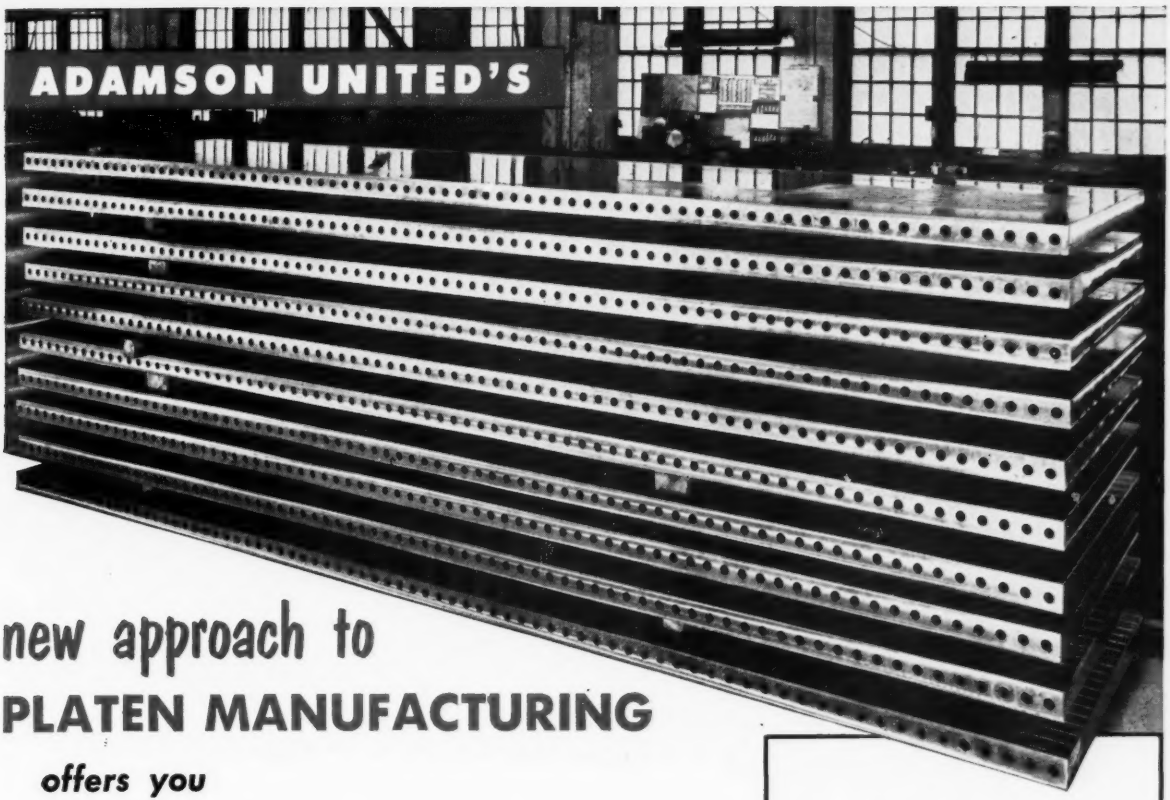
Joseph E. Quinty, Chicago sales representative of Emery Industries, Inc., becomes assistant sales manager of the company's organic chemical division and will move to the firm's home office in Cincinnati, O. **Leslie R. Graham** and **Robert H. Strawbridge,** sales representatives, have been assigned to the Chicago office from Cincinnati headquarters; while **Thomas A. Williams,** sales representative has been sent to the Philadelphia territory. **Lindsay C. Taliaferro, Jr.,** transfers to Emery's New Jersey sales territory, replacing **R. S. Haley,** now sales manager of the firm's Vopcolene Division on the West Coast.

F. S. Wittenauer has been made assistant general sales manager of Republic Rubber Division, Lee Rubber & Tire Corp., Youngstown, O.

Robert K. Petry is now director of research and development of Congoleum-Nairn, Inc., Kearny, N. J., succeeding **Paul C. Wetterau,** resigned.



Seiberling Rubber Co., Akron, O., has installed new automatic curing presses in its Ohio tire plant. Tires cured under the domes are ejected out the back on to a conveyor for delivery to the finishing and shipping department.



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New Isoprene Processes Make Likely Long-Sought Low-Priced Polyisoprene

Synthetic Rubber

Two recently announced processes for making low-cost isoprene monomer are expected to make possible the long-hoped-for development of a synthetic natural rubber at prices lower than those of natural.

The two processes, the Goodyear process for making isoprene from propylene, and the Houdry process for hydrogenating butane or isopentane to isoprene, are expected to cut the cost of isoprene monomer to that of butadiene or lower, making possible production of polyisoprene at a sales price of 25¢ a pound or less.

Unlike polybutadiene, polyisoprene has basically the same properties as natural rubber. Therefore the question of price is the key to polyisoprene use. Announcement of the two processes means that a number of producers, who have decided on butadiene production only, may shift to a production setup which will enable production of either polyisoprene or polybutadiene, depending on needs of the market.

The Goodyear process, designed to lower the price for isoprene from the present market price of 20 to 25¢ a pound to the 13-15¢ price for butadiene, is the result of five years of research and development, according to a paper given by Kenneth J. Frech, research project leader at Goodyear, in May at the joint meeting of the American Institute of Chemical Engineers and the chemical engineering division of the Chemical Institute of Canada.

Frech said that under the direction of Victor J. Anhorn, Goodyear manager of organic chemical processing, the company screened 26 possible processes, eliminating all but five. They were methylethylketone - formaldehyde, acetone - acetylene, isobutylene - formaldehyde, isopentane or isoamylene dehydrogenation, and propylene dimer pyrolysis.

The first route had high raw material costs that indicated an isoprene price of 17¢; the second, high production cost that would set a price of about 15¢; and the third production costs that would bring the price to 15-16¢, he revealed. The isopentane process looked promising, but butadiene makers had a technological lead in the area and could easily swing to isoprene production, he said. So the method of dimerizing propylene to 2-methyl-1-pentene, isomerizing it to 2-methyl-2-pentene, and converting the isomer to isoprene by thermal cracking was chosen. The process was developed jointly by Goodyear and Scientific Design.

The process was at least as cheap as other processes, and propylene, a refinery by-product, is available cheaply and in billion-pound amounts, Frech said. To make the process more efficient Goodyear developed a hydrogen-bromide catalyst system which gives higher yields at lower temperatures.

The Houdry process, also explained in a paper at the meeting, has the advantage that it can be used to produce isoprene, butadiene, or other olefins with the same equipment. Pilot-plant studies have been made on simultaneous production of isoprene and butadiene. Another advantage is that a number of different feedstocks can be used.

The process involves conversion of isopentane and/or isopentenes to isoprene in a single-step operation using a chromia-alumina catalyst.

Houdry estimates that, depending on size of plant, type, and cost of feedstocks and types of products produced, recovery facilities and other factors, isoprene can be produced at 8-12¢ a pound.

The investment in a Houdry process plant is "fairly substantial," Houdry admits, but says that the ability to convert from one product to another makes it less of a risk than a plant designed to turn out only one material.

Consumption of new rubber in the United States for March amounted to 120,360 long tons, compared with 109,530 long tons during February, according to the monthly report of The Rubber Manufacturers Association, Inc.

Consumption of all types of synthetic rubber during March amounted to 85,510 long tons, against 77,659 long tons in February. Natural rubber consumption for March was 34,850 long tons, contrasted with 31,871 long tons in February.

Synthetic rubber accounted for 71.05% of total new rubber consumption, compared with 70.90% in February. The ratio for the first three months of 1961 was 70.99%, against 67.21% for the first quarter of last year.

Consumption (in long tons) by type in March was: SBR, 70,910, against 64,710 in February; CR, 6,305, against 5,802; IIR, 5,035, against 4,544; NBR, 2,570, against 2,121; stereo elastomers, 518, against 323; and other elastomers, 172, against 159 in February.

Total synthetic rubber production totaled 112,828 long tons in March, against 101,245 long tons in February; and exports were 26,300 long tons, against 26,167 long tons. Black masterbatch production for March was 1,935 long tons, contrasted with 3,875 long tons in February; oil black masterbatch, 18,228 long tons, against 16,802 long tons in February, and oil masterbatch, 36,083 long tons, against 36,050 long tons.

Tire Cord

The world does move! In July, 1958, the heading of this tire cord market review was changed from "Rayon" to "Rayon and Nylon" in recognition of the fact that nylon tire cord producers were becoming an increasingly important factor in the market. Now the heading has been changed again because it seems certain that the two fibers will not be the only ones in the field much longer.

Specifically, Ted M. Kersker, manager of fabric and adhesives development for Goodyear Tire & Rubber Co., predicted in May that polyester fibers such as DuPont's Dacron and Beaunit's Vycron may be in commercial use for tire cord within a year.

There is little question that Dacron and Vycron fibers have some advantages for tire cord. Basically they have a good deal of the high strength and bruise resistance of nylon without nylon's growth characteristics. Because of these characteristics and their water-repellent qualities, polyester fibers are already showing signs of competing strongly with rayon in the belting field. In the tire cord field nylon's thermal

Furniture by Walter Nugent Designs, Oakville, Ontario, Canada

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—an entirely new foam rubber latex

Polysar* Latex 723 has been developed to completely replace natural latex in the manufacture of foam rubber—to give a finished product with the highest load-carrying (modulus) characteristics of any latex now available.

These improvements result from an extension of the freeze-agglomeration technique used by Polymer for the production of high solids latices. Wherever foam rubber is required, the use of a synthetic latex alone offers advantages in handling and processing. These, combined with the higher modulus of Polysar Latex 723, will produce substantial savings for the foam manufacturer.

For complete information, write: Marketing Division, Polymer Corporation Limited, Sarnia, Canada. Ask for Technical Report No. 11:2A

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Important cost saving features of

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You benefit from these advantages

1 Storage and Handling: store only one stable latex at high solids; no deammoniation is necessary before compounding.

2 Compounding and Processing: use only a small amount of soap and no auxiliary stabilizers; a high amount of zinc oxide may be added to the initial compound before maturing.

3 Foam Physical Properties: highest load carrying capacity of any latex foam rubber; with adequate processing control, properties are not sensitive to minor compounding variations; good age resistance; flex properties equivalent to natural latex foam.

TYPICAL LATEX PROPERTIES

Former designation	XPRD-860
Ratio of butadiene/styrene	70/30
Latex total solids (%)	65
pH	10.5
Viscosity (Brookfield LV, No. 3 spindle)	
—at 12 rpm. (poises)	18
—at 30 rpm. (poises)	11
Free styrene (%)	0.03
Formaldehyde preservative (ppm.)	300
Mechanical stability	good
Storage stability	very good
Coagulum on 80 mesh screen (% of dry weight)	0.04
Average particle size (Angstrom units)	1200
Mooney viscosity of contained polymer (ML/4)	150
Density of dry latex solids (g./cc.)	0.950

TYPICAL COMPOUND PROPERTIES

(for recipe based on 100% Polysar Latex 723 and 10 parts clay filler)
After curing (25 minutes in steam 212°F) and drying.

Density	lb./cu. ft.	g/cc	Compression resistance, RMA (lb/50 sq. inches at 25% deflection)
Low	4.5	.072	12.5
Medium	6.5	.104	32.5
High	8.5	.136	61.0

Density	lb./cu. ft.	g/cc	Tensile Strength (p.s.i.)
Low	4.5	.072	6.0
Medium	6.5	.104	8.8
High	8.5	.136	13.4

Elongation at Break (%)	190
Compression Set (%)	6.8
Volume Shrinkage (%)	13.7

Aged in Air (% change after 22 hours at 212°F)	
	Compression Resistance + 9
	Tensile Strength −13
	Elongation at Break −31

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DA

shrinkage tends to counteract growth, but it still results in flat spotting, a negligible factor with rayon.

The polyesters have two disadvantages at this point. For one thing, researchers have had trouble obtaining good fabric-rubber adhesion with polyesters. But Goodyear believes it has just about solved that problem, Kersker declared.

For another thing, the price of Dacron and Vycron is about $1.50 a pound, compared with 92¢ for nylon and 51¢ for rayon. Producers believe, however, that prices can be brought down considerably if the fiber is put into quantity production. Not much more than three years ago the price of nylon was $1.30 a pound.

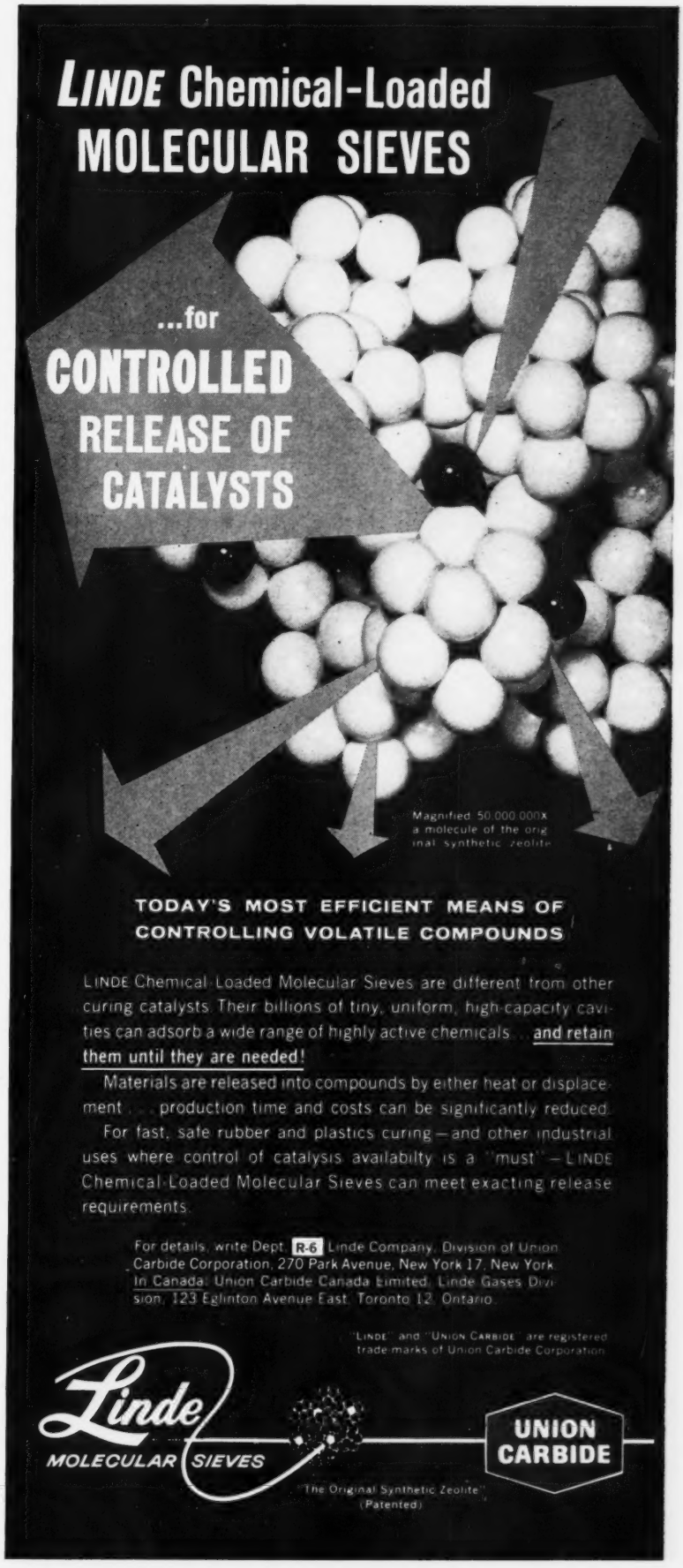
Kersker said that the real sleeper in the tire cord field is polyolefin fibers. Development of a commercial tire cord from polyolefins may be as much as 10 years off, however, he added. He didn't specify what polyolefins he had in mind, but the assumption is that polypropylene or polyethylene, both under intensive development, is the fiber referred to.

The Goodyear development head said that polyolefin fibers, which he called "the most important fiber discovery since nylon," are lighter than nylon, would be cool running, and have a molecular structure which can be controlled in manufacture, making for a stronger fiber than the polyesters, which cannot be so controlled. Considerable research and testing, however, remain to be done, he said. At the moment the polyolefins are available only in experimental quantities, and the ultimate price of a polyolefin tire cord is anybody's guess.

According to Eastman Chemical Products, Inc., capacity for production of polypropylene resin is expected to reach 460 million pounds a year by the end of 1962. Texas Eastman Co. has just gone on stream with a 20-million-pounds-a-year plant at Longview, Tex. Other producers are AviSun Corp., New Castle, Del., 100 million pounds; Hercules Powder Co., Parlin, N. J. and Lake Charles, La., part of a total of 200 million pounds of polypropylene and polyethylene; Humble Oil & Refining Co., Houston, Tex., 125 million pounds; and Novamont Corp., a subsidiary of Montecatini, in a plant at Neal, W. Va., 25 million pounds. Also expected to build plants are Dow Chemical Co., Firestone Plastics Co., and Shell Chemical Co. Foreign producing capacity is expected to increase from 118 million pounds at present to 400 million pounds at the end of 1963.

Of the more than 400 million pounds to be produced here, only about 25 million pounds are expected to be used for textile fibers. Use for tire cord, however, could double that figure.

Du Pont announced during the month that a pilot plant for production of HT-1, a highly heat-resistant polyamide, is being built at the company's Richmond, Va., plant. It is expected that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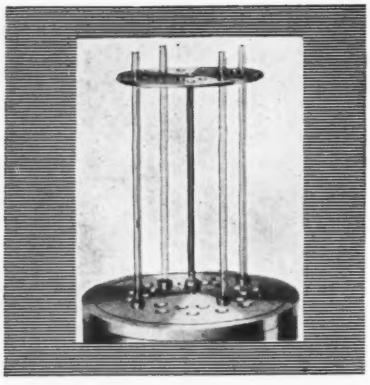

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FOR COMPLETE FACTS on the Scott Model LG with attachments for immersion testing, or standard Model LG for test tube aging, write to Scott Testers, Inc., 90 Blackstone St., Providence, R. I. Tel. DExter 1-5650 (Area Code 401).

SCOTT TESTERS

THE SURE TEST... SCOTT!

market reviews

the product will be used for airplane tires, but the company also said that the new fiber will show promise for industrial uses for electrical insulation, special-duty beltings, and high-temperature hose.

Packaged production of high-tenacity rayon yarn in April was 18.8 million pounds, compared with 22.5 million in March, according to *Textile Organon*. Domestic shipments were 15.2 million pounds, against 20.5 million pounds in March, and total shipments 17.5 million pounds, compared with 23.2 in March. End-of-month stocks were 18.7 million pounds, against 17.4 million in March.

RAYON PRICES

Tire Fabrics

1100/490/2	$0.69
1650/908/2	$0.58/.615

Tire Yarns

High-Tenacity	
1100/490	.51
1100/980	.51
1150/490, 980	.51
1230/490	.51
1650/980	.57
1875/980	.57
2200/980	.57
Super-High Tenacity	
1650/720	.57

NYLON PRICES

Tire Yarns

840/140	.92
1680/280	.92

Natural Rubber

Prices of natural rubber continued to edge up during the April 16-May 15 period, spurred by the uncertain situation in Laos and generally improving factory demand in the United States.

The general tone of the market was optimistic, so much so that the report on May 9 of a new Goodyear process to produce low-cost isoprene to produce what may be a 25¢ polyisoprene dropped prices for only one day. The reasoning, presumably, is that it will be a number of months before Goodyear actually gets into production, and a considerably longer period before polyisoprene is produced in large enough quantity to have any effect on demand for natural rubber.

The General Services Administration announced that 4,361 tons of stockpile rubber were sold during April, compared with 3,719 tons in March. This brings sales for the year so far to 11,533 tons. Total stockpile sales since October, 1959, amount to 107,256 tons.

April sales on the New York Commodity Exchange on the Rex Contract totaled 10,400 tons, against 11,970 for March, and Standard Contract sales, 880 tons, against 146 in March. Near rubber closed out the April 16-May 15 period at 31.80¢, compared with 30.85¢ at the close of the previous period. There were 20 trading days in March and 21 in the March 16-April 15 period.

On the physical market, the average price of RSS #1 for April was 31.22¢, compared with 30.20¢ for March, and 32.05¢ for the April 16-May 15 period, compared with 30.40¢ for the March 16-April 15 period. Average April sellers' prices of other grades were RSS #3, 30.75¢; Amber Blankets, 25.97¢, and Flat Bark, 21.18¢.

REX CONTRACT

1961	Apr. 21	Apr. 28	May 5	May 12
May	32.05	32.35	31.25	31.40
July	32.05	32.15	31.85	31.55
Sept.	31.98	31.85	31.60	31.10
Nov.	31.80	31.78	31.45	30.95
1962				
Jan.	31.65	31.59	31.20	30.87

STANDARD CONTRACT

1961	Apr. 21	Apr. 28	May 5	May 12
May	31.98	31.95	31.25	31.40
July	31.90	31.95	31.55	31.35
Sept.	31.83	31.65	31.30	30.90
Nov.	31.65	31.60	31.15	30.80
1962				
Jan.	31.50	31.40	30.90	30.75
Mar.	31.40	31.40	30.90	30.60
May	31.35	31.35	30.85	30.60

NEW YORK OUTSIDE MARKET

	Apr. 21	Apr. 28	May 5	May 12
RSS #1	32.25	32.00	32.00	32.00
#2	32.13	31.75	31.63	31.75
#3	32.00	31.50	31.37	31.50
Pale Crepe				
#1 Thick	34.75	34.50	34.75	34.75
Thin	34.25	34.00	34.25	34.25
#3 Amber Blankets	26.75	26.50	27.00	27.00
Thin Brown Crepe	26.50	26.25	26.75	26.34
Standard Flat Bark	21.75	21.50	21.75	21.75

Scrap Rubber

The scrap rubber market picked up considerably during the April 16-May 15 period as consumption began to increase. Prices of mixed auto tires remained unchanged, but mixed auto tubes rose from 4¢ to 4½¢, and butyl tubes from 5¾¢ to 6¼¢.

	Eastern Points	Akron, O.
	Per Net Ton	
Mixed auto tires	$7.00/$11.00	$11.00
S.A.G. truck tires	nom.	nom.
Peeling, No. 1	nom.	25.00
2	nom.	nom.
3	nom.	nom.
	(¢ per Lb.)	
Auto tubes, mixed	4.50	4.50
Black	5.75	5.75
Red	nom.	nom.
Butyl	6.25	6.25

Latex

The drum latex market showed some signs of improvement during the April 16-May 15 period. As a result of a good amount of offtake, supplies for nearby shipment are becoming scarce, and moderate interest has been shown in more forward shipment.

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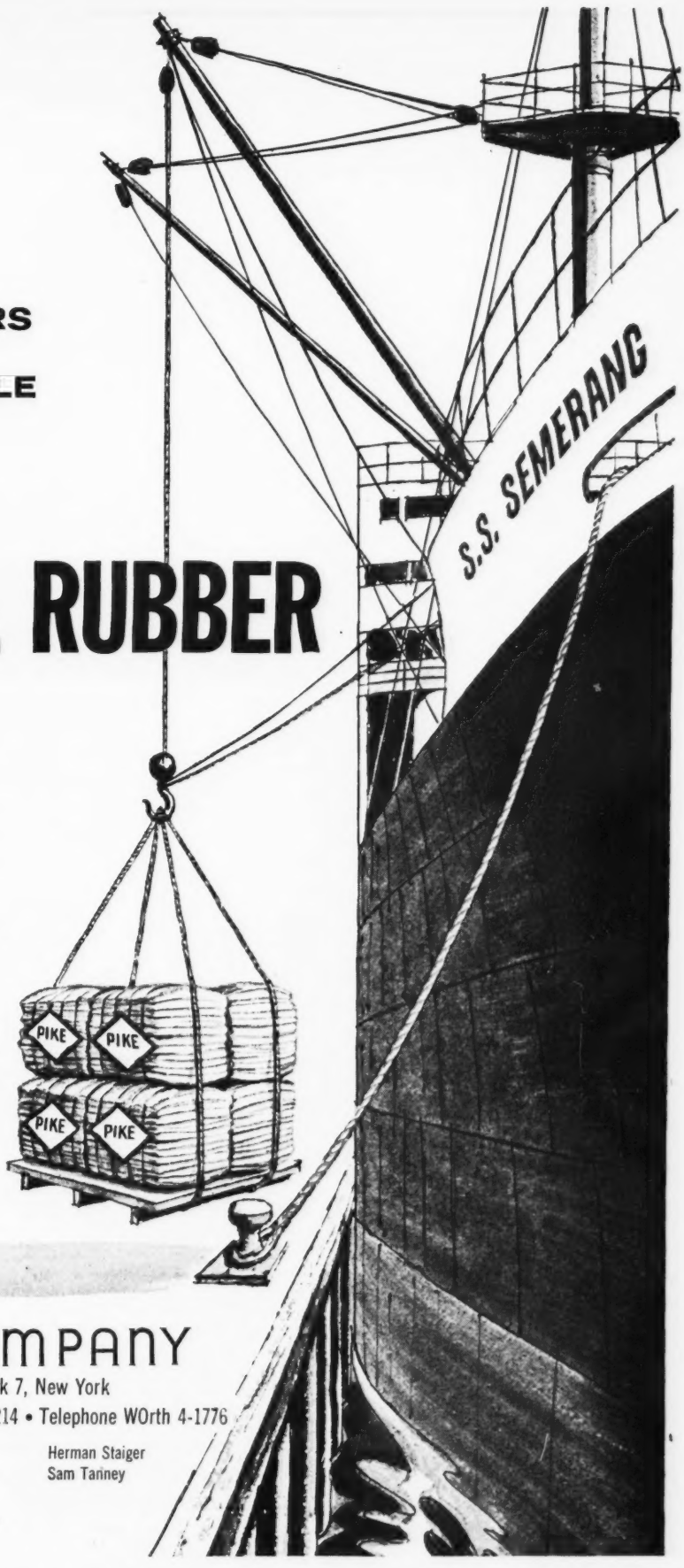

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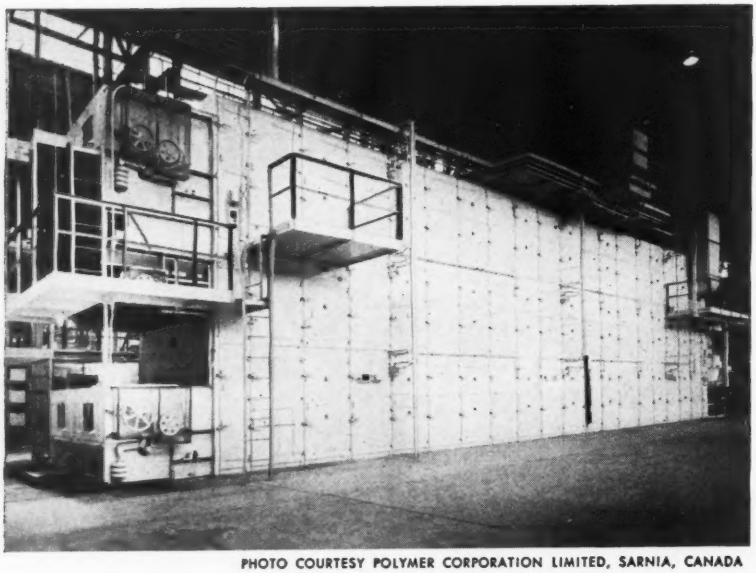

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Features developed by SARGENT over many years of designing and building rubber dryers include: Silicone spraying at the feed end to help prevent caking or rolling up of the crumb; Dryer sections zoned in groups with separate temperature and humidity controls; Highly efficient airlocks between dryer and cooler compartments; Breakers and brushes to assure a clean conveyor, and to reduce maintenance time and cost; Design that solved the dust problem . . . collectors are not needed at exhausts; A single housing for dryer and cooler . . . increases efficiency speeds the process cycle, lessens possibility of contamination of stock; Housing is covered with full size hinged doors and easily-removed panels for easiest possible cleanout, in least time; Every known safety device for protection of personnel, machine and stock; An exclusive precision pre-assembly method that guarantees the easiest, speediest, lowest cost installation of any dryer on the market. The SARGENT shown above, for example, is believed to be the largest of its type ever built. Yet it was erected at the customer's plant in less than four weeks. This recently installed 3-pass synthetic rubber dryer with cooler is gas-fired. Only 2 gas burners are needed to bring the huge dryer up to working temperature in less than ten minutes.

Gas burners, safety certified of course, may be mounted on top of the dryer section for more efficient operation, easier servicing. Heat source for SARGENT dryers may also be oil, steam or electricity.

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market reviews

Production in Malaya during March was 6,853 tons, compared with 6,411 tons in February. Stocks at the end of March were 6,127 tons, against 7,421 tons on February 28.

United States consumption of natural latex for March was 3,575 tons and for synthetic latices, 9,010 tons. For the first quarter the figures were 10,398 tons of natural latex and 25,204 tons of synthetic latices, a total of 35,602 tons, contrasted with 15,801 tons of natural and 30,124 tons of synthetic latices during the first quarter of last year, a total of 45,925 tons.

Prices for ASTM centrifuged natural latex, in tank-car quantities f.o.b. tank car, were 37.17¢ per pound solids on May 15, against 36.37¢ on April 15. Synthetic latices prices remained at 26 to 40.24¢ for SBR, 37 to 57¢ for CR, and 45 to 60¢ for NBR.

(All figures in long tons, dry weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Feb.	0	4,719	3,298	10,280
Mar.	0	*	3,575	10,318
SBR				
Feb.	6,286	—	6,303	8,801
Mar.	8,500	—	6,866	9,254
Neoprene				
Feb.	817	—	727	1,508
Mar.	1,205	—	936	1,927
Nitrile				
Feb.	966	—	713	2,247
Mar.	763	—	904	2,124

* Not available yet for period covered.

Reclaimed Rubber

Reclaimed rubber business continued quite slow during the April 16-May 15 period. An eastern reclaiming company said, however, that its customers had reported business improved, which should indicate an upswing in reclaim business in the near future.

According to the monthly report of The Rubber Manufacturers Association, Inc., 20,790 long tons of reclaimed rubber were consumed during March, compared with 18,550 long tons during February. A total of 21,900 tons of reclaim was produced during March, against 19,724 long tons during February. Exports for March were 1,090 long tons, compared with 1,208 in February.

RECLAIMED RUBBER PRICES

Whole tire, first line	$0.115
Third line	.1075
Inner tube, black	.17
Red	.22
Butyl	.16
Light carcass	.22
Mechanical, light-colored, medium gravity	.185
Black, medium gravity	.10

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims, in each general group separately featuring characteristic properties of quality, workability, and specific gravity, at special prices.

SILICONE NEWS from Dow Corning

Cut Rejects; Lower Costs!

CUTS REJECT RATE . . . giant tires release easily and surface details are perfect . . . no costly reject problem here thanks to heat-stable Dow Corning Silicones.

For the Rubber Industry . . . In other areas of the rubber industry too, Dow Corning Silicones have proved to be time and money savers—as electrical insulation for mill and mixer motors; as anti-adhesive coatings for bags, containers and interleaving; as heat-resistant paints that also resist weathering and corrosive atmospheres; as lubricants for ball bearings; and as Silastic® gums and bases for compounding silicone rubber stocks to meet severe requirements. Write for more information.

Dow Corning Silicone Mold Lubricants Assure Quick, Clean, Easy Unloading

Recent field reports indicate more and more tire molders are standardizing on Dow Corning silicone release agents to assure perfect performance every time. That means clean release without sticking; sharp surface details . . . tires that look their very best.

Economical to use, these silicone mold lubricants cut mold cleaning time down to almost nothing and at the same time increase mold service life, keep rejects to a minimum, and speed production. Applying Dow Corning silicone mold lubricants is a snap . . . spray into intricate grooves, or wipe onto smooth surfaces.

Whatever the fabrication problem—from releasing green tires to lubricating Bag-O-Matic bladders—there's a Dow Corning silicone lubricant that's effective, economical and easy-to-use. Available in different forms, too: water-dilutable emulsions, solvent soluble fluids, greaselike compounds, stable dispersions.

EASILY APPLIED . . . Dow Corning silicone mold lubricants can be sprayed easily to reach tiny openings, and assure clean, easy release.

You can't find better release agents for rubber and plastic products than Dow Corning Silicones. Get more facts now. Write Dept. 9618a.

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statistics of the rubber industry

U. S. Consumption of Natural And Synthetic Rubber*

(Long Tons)

Year	Natural	SBR	IIR	CR	NBR	Total
1960						
June	42,576	80,951	5,150	7,129	2,619	138,425
July	35,229	67,853	4,597	4,936	2,027	114,642
Aug.	37,528	73,761	4,880	7,200	2,737	125,836
Sept.	36,770	72,593	4,901	7,906	2,740	124,100
Oct.	37,033	74,606	4,552	6,920	2,706	125,817
Nov.	35,965	72,702	4,455	6,372	2,650	122,144
Dec.	31,891	67,549	4,229	5,983	2,315	111,967
1961						
Jan.	35,512	71,653	5,143	6,345	2,591	121,244
Feb.	31,871	64,710	4,544	5,802	2,121	109,624
Mar.	34,908	71,110	5,005	6,592	2,559	120,916

* Including latex.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	SBR	CR	NBR	Total Synthetic	Natural and Synthetic
1960						
June	3,335	7,541	965	973	9,479	12,814
July	3,483	6,481	953	983	8,417	11,900
Aug.	4,174	8,096	978	1,291	10,365	14,539
Sept.	2,541	9,397	1,119	1,299	11,815	14,356
Oct.	2,042	9,063	1,272	1,176	11,511	13,553
Nov.	3,456	7,205	1,169	1.328	9,702	13,158
Dec.	3,572	6,934	660	996	8,590	12,162
1961						
Jan.	4,761	7,821	853	1,174	9,848	14,609
Feb.	4,719	6,286	727	966	8,069	12,788
Mar.	....	8,500	936	763	10,468	....

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Imports and Production of Natural and Synthetic Rubber*

(In Long Tons)

Year	Natural	SBR	IIR	CR	NBR	Natural and Synthetic
1960						
June	31,639	98,635	9,475	11,614	2,823	154,186
July	28,555	95,584	8,389	10,210	2,401	144,939
Aug.	39,596	98,541	9,804	10,120	3,170	161,231
Sept.	31,862	90,392	9,183	10,078	3,190	144,715
Oct.	26,908	87,857	8,711	11,219	3,204	137,899
Nov.	30,411	87,540	8,365	11,261	3,299	140,876
Dec.	39,084	86,242	3,951	11,291	3,175	153,743
1961						
Jan.	33,750	84,619	6,066	11,896	3,230	139,561
Feb.	26,766	79,892	7,875	10,344	3,134	128,011
Mar.	....	89,779	9,486	10,073	3,242	....

* Including latex.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	SBR	CR	NBR	Total Synthetic	Natural and Synthetic
1960						
June	3,975	7,147	1,033	981	9,161	13,136
July	2,912	5,433	729	780	6,942	10,854
Aug.	3,897	7,857	1,057	1,078	9,992	13,889
Sept.	4,250	7,458	942	1,122	9,522	13,772
Oct.	4,283	7,371	971	1,118	9,460	13,743
Nov.	4,338	7,171	914	1,104	9,189	13,527
Dec.	3,588	6,756	750	898	8,404	11,992
1961						
Jan.	3,525	6,667	779	1,005	8,451	11,976
Feb.	3,295	6,303	727	713	7,743	11,038
Mar.	3,575	6,866	936	904	8,706	12,281

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Exports of Synthetic Rubber*

(Long Tons)

Year	SBR	IIR	CR	NBR	Total
1960					
June	23,130	2,062	3,699	464	29,355
July	19,721	3,792	4,446	616	28,575
Aug.	22,753	3,494	3,519	501	30,267
Sept.	16,836	3,500	3,340	389	24,065
Oct.	15,439	2,922	3,913	629	22,903
Nov.	17,792	1,928	2,760	546	23,026
Dec.	17,415	2,282	2,775	759	23,231
1961					
Jan.	18,180	2,273	5,047	545	26,045
Feb.	18,949	2,425	4,010	785	26,384

* Including latices.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Reclaimed Rubber*

(Long Tons)

Year	Production	Consumption	Exports	Stocks
1960				
June	25,429	24,677	1,164	31,699
July	21,472	19,249	1,384	33,624
Aug.	23,540	21,452	951	33,979
Sept.	22,251	22,101	1,028	33,949
Oct.	23,546	23,269	804	33,519
Nov.	22,013	21,014	1,167	33,783
Dec.	20,010	19,921	859	33,048
1961				
Jan.	22,528	22,052	1,084	33,101
Feb.	19,724	18,550	1,208	33,493
Mar.	21,824	20,558	....	32,695

* Natural and synthetic.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

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CLAIRTON, PENNSYLVANIA

Carbon Black Statistics—Jan.-Mar., 1961

Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; GPF, general-purpose furnace black; FEF, fast-extruding black; HAF, high abrasion furnace black; SAF, super abrasion furnace black; ISAF, intermediate super abrasion furnace black.

(Thousands of Pounds)

	Jan.	Feb.	Mar.
Production			
Furnace types			
Thermal	12,195	11,630	12,724
SRF	24,487	20,005	24,173
HMF	2,774	4,191	5,116
GPF	11,847	12,077	12,782
FEF	17,025	19,145	16,824
HAF	45,286	33,369	42,988
SAF	218	3,057	1,094
ISAF	26,373	23,881	29,363
Total furnace	140,205	127,355	145,064
Contact types	24,056	21,732	22,427
Totals	164,261	149,087	167,491
Shipments			
Furnace types			
Thermal	12,294	10,601	12,227
SRF	21,902	22,151	24,722
HMF	4,381	5,007	5,234
GPF	11,882	10,896	12,714
FEF	17,829	16,728	17,657
HAF	38,837	38,389	40,167
SAF	1,498	1,055	1,587
ISAF	25,796	22,670	27,310
Total furnace	134,419	127,497	141,668
Contact types	22,640	21,906	22,832
Totals	157,059	149,403	164,600
Producers' Stocks, End of Period			
Furnace types			
Thermal	22,875	23,904	24,429
SRF	44,448	42,302	41,703
HMF	8,753	7,937	7,819
GPF	8,747	9,928	9,996
FEF	18,319	20,736	19,156
HAF	63,268	57,877	58,436
SAF	3,267	5,269	3,891
ISAF	35,017	36,228	38,028
Total furnace	204,694	204,181	204,454
Contact types	73,542	73,368	72,963
Totals	278,236	277,549	276,417
Exports			
Furnace types			
Total furnace	29,965	27,614	.....
Contact types	10,598	11,989	.....
Totals	40,563	39,603	.....

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

U. S. Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1959	3,624	41,522	890	46,036	46,059	10,536
1960	3,320	36,511	1,120	40,982	40,851	11,034
Nov.	229	2,354	74	2,657	2,921	10,859
Dec.	224	2,498	95	2,817	2,913	11,034
1961						
Jan.	237	4,783	56	5,076	3,208	9,394
Feb.	231	2,988	58	3,277	3,140	9,246
Mar.	281	3,246	60	3,588	3,359	9,014

Source: The Rubber Manufacturers Association, Inc.

U. S. Automotive Pneumatic Casings

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
Passenger Car						
1960	36,321	65,222	895	95,685	105,466	23,583
July	2,456	6,377	82	8,915	8,680	22,097
Aug.	1,359	6,389	76	7,824	8,061	22,326
Sept.	2,676	5,749	59	8,484	8,158	22,037
Oct.	3,342	5,366	53	8,760	8,461	21,816
Nov.	3,171	4,123	55	7,348	7,979	22,493
Dec.	2,844	3,900	55	6,799	7,809	23,583
1961						
Jan.	2,191	5,955	44	8,189	8,234	23,691
Feb.	1,930	4,152	43	6,125	7,643	25,268
Mar.	2,134	5,876	72	8,082	8,195	25,385
Truck and Bus						
1960	3,686	9,249	728	13,875	14,463	3,797
July	279	851	68	1,197	1,109	4,011
Aug.	219	823	75	1,117	1,085	3,972
Sept.	273	811	61	1,146	1,026	3,856
Oct.	247	938	68	1,254	1,069	3,683
Nov.	255	649	51	955	1,066	3,797
Dec.	243	552	56	851	995	3,957
1961						
Jan.	258	635	48	941	988	3,991
Feb.	261	569	49	879	948	4,070
Mar.	313	719	52	1,084	1,016	4,000
Total Automotive						
1960	40,203	77,773	1,751	119,698	111,569	27,540
July	2,735	7,228	150	10,113	9,789	26,108
Aug.	1,578	7,213	151	8,941	9,147	26,298
Sept.	2,950	6,560	120	9,630	9,184	25,893
Oct.	3,589	6,304	121	10,014	9,530	25,499
Nov.	3,425	4,772	105	8,303	9,044	26,290
Dec.	3,087	4,452	112	7,650	8,804	27,540
1961						
Jan.	2,449	6,590	91	9,130	9,221	27,682
Feb.	2,191	4,722	92	7,004	8,591	29,338
Mar.	2,448	6,595	123	9,166	9,212	29,385

Source: The Rubber Manufacturers Association, Inc.

U. S. Rubber Industry Economic Indicators

Year	Production Index*: Total Rubber and Plastics Products Seasonally Adjusted, % 1947-49 = 100	Production Index*: Total Rubber and Plastics Products Seasonally Adjusted, % 1957 = 100	Production Index*: Total Rubber and Plastics Products Without Seasonal Adjustment, % 1947-49 = 100	Production Index*: Total Rubber and Plastics Products Without Seasonal Adjustment, % 1957 = 100	% Return†: On Sales R&MP‡	% Return†: On Investment R&MP
1960						
July	204	117	177	101		
Aug.	201	115	191	109		
Sept.	194	111	196	112	3.3	6.8
Oct.	192	110	202	116		
Nov.	192	110	196	112		
Dec.	184	105	176	101	3.2	6.4
1961						
Jan.	180	103	189	108		

* F.R.B. Index of Industrial Production revised to include plastics products and change base period.

† Base Data F.I.C.-S.E.C.-Quarterly Financial Reports—% Calculated by RMA.

‡ R&MP = Rubber and Miscellaneous Plastics, a classification revised according to the 1959 Standard Industrial Classifications.

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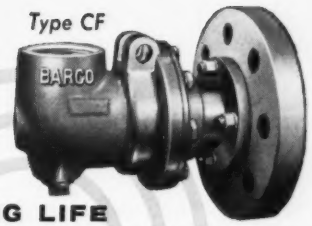

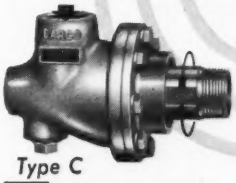

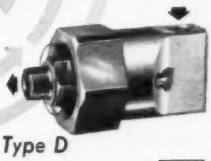

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World Production of Natural Rubber

(1,000 Long Tons)

Year	Malaya Estate	Malaya Native	Indonesia Estate	Indonesia Native	All Other	Total
1960						
May	33.0	23.8	16.7	32.3	54.2	160.0
June	34.3	24.0	16.7	31.8	54.6	160.0
July	37.1	26.0	17.9	27.9	46.1	155.0
Aug.	36.1	26.0	16.9	17.3	59.2	152.5
Sept.	36.6	25.1	16.2	36.9	56.7	172.5
Oct.	37.1	26.0	18.1	36.0	55.3	172.5
Nov.	35.3	21.6	18.7	17.0	57.4	150.0
Dec.	39.2	27.7	20.0	51.2	66.9	205.0
1961						
Jan.	40.5	26.9	19.1	...	...	...
Feb.	31.8	26.0	18.6	...	...	...

Source: Secretariat of the International Rubber Study Group.

World Consumption of Natural Rubber*

(1,000 Long Tons)

Year	U. S.	Eastern Europe and China†	U. K.	France	Germany	World Total†
1960						
June	42.6	35.9	16.4	11.2	10.8	175.0
July	35.2	29.8	11.2	10.3	10.8	155.0
Aug.	37.3	31.5	10.2	4.0	11.3	152.5
Sept.	36.8	30.1	16.7	11.5	11.8	165.0
Oct.	37.0	33.3	14.2	11.7	10.9	162.5
Nov.	36.0	33.0	13.8	10.7	11.5	162.5
Dec.	31.9	27.7	13.7	11.3	10.0	150.0
1961						
Jan.	35.1	42.5	12.3	...	11.6	167.5
Feb.	31.9	...	...	...	...	...

* Figures include latices.
† Estimated or partly estimated.
Source: Secretariat of the International Rubber Study Group.

World Production of Synthetic Rubber*

(1,000 Long Tons)

Year	U. S.	Canada	Germany	U. K.	Italy	Japan	Total
1960							
June	122.5	13.5	5.4	8.1	5.5	3.3	160.0
July	116.6	12.8	7.8	7.4	6.0	3.5	157.5
Aug.	121.6	12.7	7.2	7.9	6.0	2.1	160.0
Sept.	112.9	12.7	6.0	8.2	6.5	0.8	150.0
Oct.	111.0	14.3	7.0	6.3	6.5	1.7	152.5
Nov.	110.5	13.4	7.8	7.9	6.5	2.1	150.0
Dec.	104.7	13.9	6.9	9.9	6.5	2.0	147.5
1961							
Jan.	105.8	13.8	6.8	8.3	..	2.7	150.0
Feb.	101.2	...	..	..	..	..	...

* Figures include latices. No data available from Iron Curtain countries.
Source: Secretariat of the International Rubber Study Group.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U. S.	Canada	U. K.	France	Germany	Japan	Total†
1960							
June	95.8	5.0	10.0	8.0	8.2	4.9	152.5
July	79.4	3.9	7.8	7.4	8.4	5.4	132.5
Aug.	88.6	3.8	7.0	3.2	9.1	5.4	142.5
Sept.	87.3	5.0	11.3	8.6	9.4	5.4	150.0
Oct.	88.8	4.5	9.6	8.7	9.3	..	152.5
Nov.	86.2	5.2	9.2	..	9.6	..	150.0
Dec.	80.0	4.5	9.5	8.7	8.8	5.7	142.5
1961							
Jan.	85.7	4.4	8.8	..	9.8	5.7	152.5
Feb.	77.1	..	..	..	..	..	...

* Including latices.
† Figures estimated. No account has been taken of synthetic rubber originating in Eastern Europe.
Source: Secretariat of the International Rubber Study Group.

U. S. Rubber Industry Employment Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumer's Price Index
All Rubber Products					
1939	121.0	$27.84	39.9	$0.75	
1960					
July	191.7	103.53	40.6	2.55	126.6
Aug.	197.0	100.15	39.9	2.51	126.6
Sept.	197.8	98.28	39.0	2.52	126.8
Oct.	197.9	101.49	39.8	2.55	127.3
Nov.	192.6	99.57	39.2	2.54	127.4
Dec.	190.6	99.58	38.9	2.56	127.5
1961					
Jan.	188.5	99.57	39.2	2.54	127.5
Feb.	184.5	...	...	...	127.5
Tires and Tubes					
1939	54.2	$33.36	35.0	$0.96	
1960					
July	75.9	123.71	41.1	3.01	
Aug.	75.7	115.25	39.0	2.94	
Sept.	74.5	112.40	38.1	2.95	
Oct.	73.8	117.00	39.0	3.00	
Nov.	73.1	114.60	39.5	2.08	
Dec.	18.4	79.00	37.8	2.09	
1961					
Jan.	18.3	81.90	39.0	2.10	
Rubber Footwear					
1939	14.8	$22.80	37.5	$0.61	
1960					
July	17.6	82.21	40.3	2.04	
Aug.	18.2	81.20	40.1	2.02	
Sept.	18.5	79.18	39.2	2.02	
Oct.	18.5	82.59	39.9	2.07	
Nov.	17.4	82.16	39.5	2.08	
Dec.	18.4	79.00	37.8	2.09	
1961					
Jan.	18.3	81.90	39.0	2.10	
Other Rubber Products					
1939	51.9	$23.34	38.9	$0.61	
1960					
July	98.2	91.66	40.2	2.28	
Aug.	102.2	92.75	40.5	2.29	
Sept.	104.8	92.10	39.7	2.32	
Oct.	105.6	93.73	40.4	2.32	
Nov.	102.1	92.17	39.9	2.31	
Dec.	100.7	89.40	38.7	2.31	
1961					
Jan.	99.2	91.01	39.4	2.31	

Source: BLS, United States Department of Labor.

U. S. Rubber Use by Products

(1,000 Long Tons)

Year	Transportation Natural	Transportation Synthetic	Transportation Total	Non-Transportation Natural	Non-Transportation Synthetic	Non-Transportation Total	Grand Total
1960							
1st qt.	94.8	176.1	270.9	44.8	110.0	154.7	425.7
2nd qt.	87.2	176.7	263.9	38.7	101.4	140.0	404.0
3rd qt.	73.7	160.4	234.0	35.6	95.0	130.5	364.5
4th qt.	67.9	157.9	225.7	37.0	97.2	134.2	359.9
1961							
1st qt.	66.3	156.8	223.1	35.6	93.1	128.8	351.9

Source: United States Department of Commerce, Business & Defense Services Administration.

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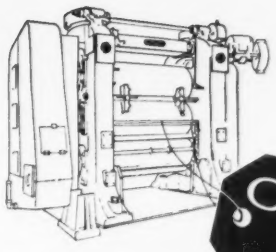

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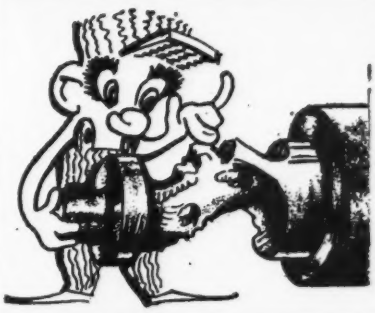

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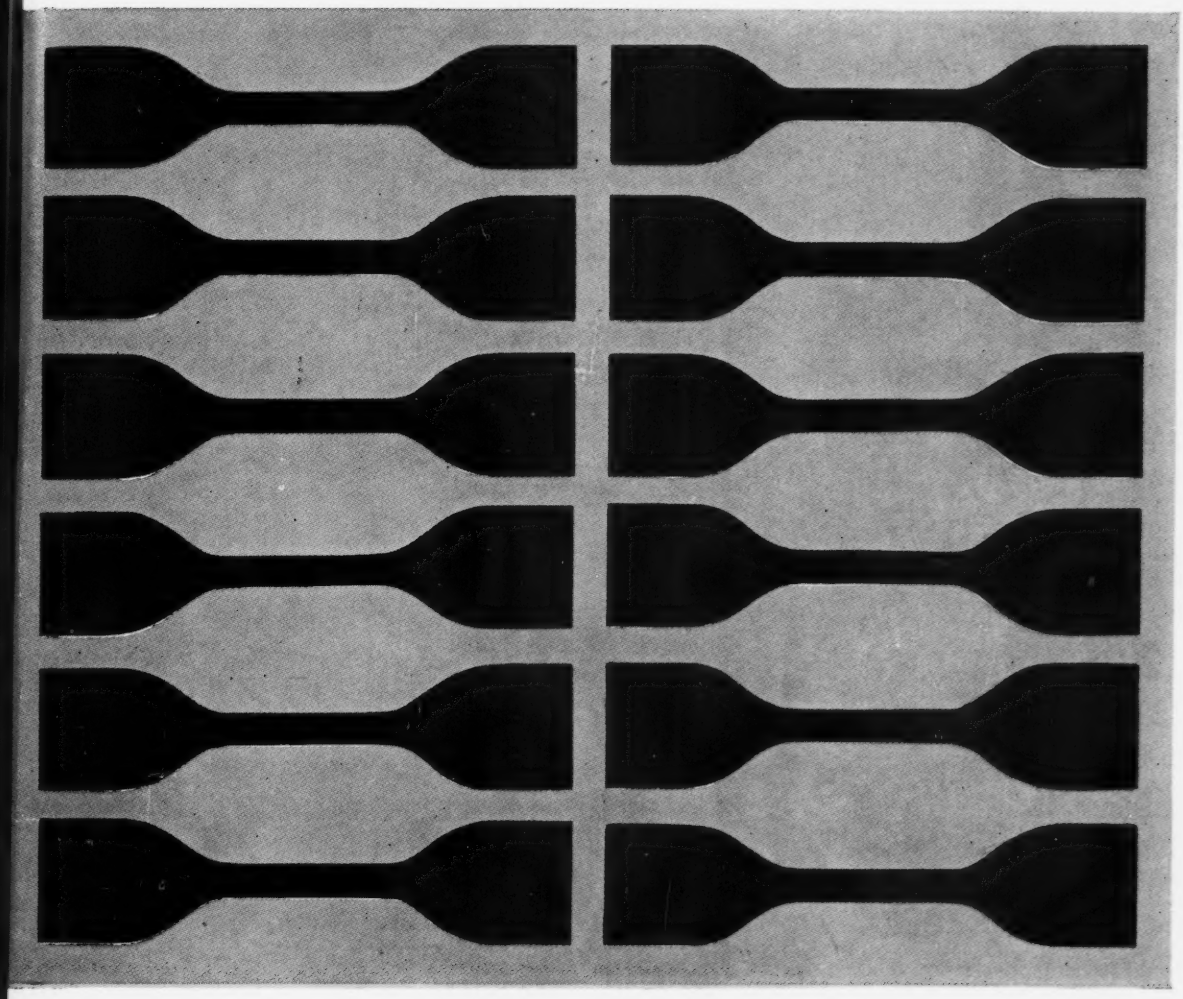

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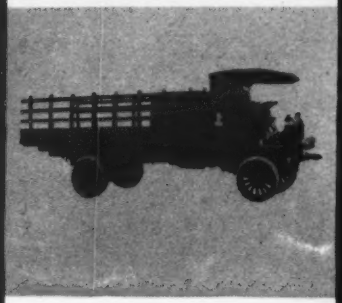

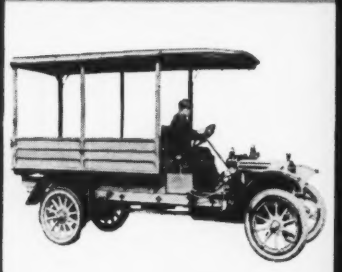

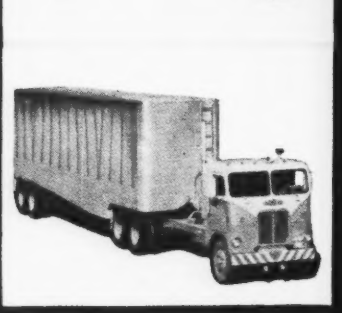

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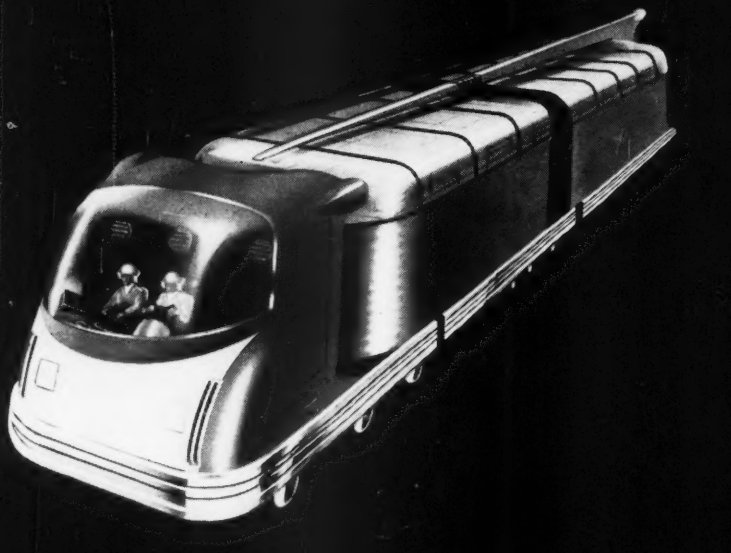

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